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EVOLUTION IN THE VEGETABLE KINGDOM.

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THE law of biologic evolution (for it is no longer a mere "doctrine") may be regarded as fairly established, no large and respectable body of scientific men being any longer found to oppose it when stated in its most general form, while difference of opinion and discussion have narrowed down to the more special aspects and minor details. In the animal kingdom, where organization is generally so high and structure so definite, great progress has been made in discovering the particular lines along which development has taken place and something like a true genealogy of the existing types has been worked out. The law of phylogeny is abundantly established by palæontology and surprisingly confirmed by embryological ontogeny.

In the vegetable kingdom this last important class of evidence is almost wholly wanting, and palæontological evidence, owing to the lower structural rank of plants, is far less complete and convincing than in the animal.

It is proposed in this article briefly to inquire what vegetable palæontology has to present in favor of evolution in plants. The subject may be considered under three somewhat distinct points of view, the historical, the geological and the botanical.

I. HISTORICAL VIEW.

It is a common observation that botany is far behind zoölogy in supporting advanced biological theories. This is still more strikingly true of the study of extinct than of that of living forms, for not only were the ancients wholly unacquainted with any form of vegetable petrifaction, although familiar with fossil shells,

madrepores and other animal remains, but when at last the era of science dawned toward the close of the eighteenth century Blumenbach had for many years been sounding the key-note of palæontological truth in the animal kingdom before Schlotheim took up the refrain in favor of plants.

When we consider the present state of knowledge respecting the geological strata of the earth's crust, we can scarcely realize that but two generations ago comparatively nothing was known on this subject. Geology was not yet born. The investigators of the last century were really not discussing the geologic age of fossil remains. With those who studied fossil plants the assumption was universal that they were plants that grew somewhere in the world only a few thousand years ago at most, plants such as either grew then in the countries where their remains were found or in other countries from which they had been brought by one agency or another, generally that of the Flood, or else, as some finally conceived, had been destroyed by these agencies, so as to have no exact living representatives.

In the year 1804 appeared Baron von Schlotheim's "Flora der Vorwelt," as it is now universally quoted, although the author himself merely entitled it a "description of remarkable plant impressions and petrifactions—a contribution to the flora of the former (or primeval) world." To us this seems modest enough, but in view of the history of palæontology, the second part of this title amounted to a bold declaration, and accordingly we find him defending it in his introduction by these words: "The petrifactions which so early engaged the attention of investigators, and which, without doubt, afforded one of the first incentives to the founding of mineral collections and to the earnest study of mineralogy and geology, have, as is well known, since Walch began to arrange them systematically, been for a long time, as well in as out of Germany, almost wholly neglected. They were content to regard them as incontestable proofs of the Deluge, which closed all further investigation until they were at last compelled to explain their occurrence through other great natural operations which had probably been going on earlier and more universally than the flood described in the Bible, and influencing the formation of the upper strata of the earth's crust; and more recent observations and investigations have even led us to the very probable supposition that *they may be the remains of an*

earlier so-called pre-Adamitic creation, the originals of which are now no longer to be found. * * * In the continued investigation of this subject this opinion, with certain restrictions, has in fact gained a high degree of probability with the author of the present work, so that he ventures to announce his treatise as a contribution to the flora of the ancient world (Vorwelt)." Since its introduction by Schlotheim this expression, "Flora der Vorwelt," has been applied to nearly all the German works on fossil plants, and "Beiträge zur Flora der Vorwelt" still continue to appear.

This work was followed, though sixteen years later, by his "Petrefactenkunde," and also by Count Sternberg's important "attempt at a geognostico-botanical presentation of the flora of the ancient world." These men were the pioneers of vegetable palæontology. It was reserved for Adolphe Brongniart to become its true founder. Brongniart's paper on the classification and distribution of fossil plants, which was published in the memoirs of the Paris Müseum of Natural History in 1822, showed that he had already been some time at work, and after six years of nearly complete silence he at length came forward, in 1828, with his epoch-making works on the history of fossil plants—the "Prodrome" and the "Histoire des végétaux fossiles"—which, taken together as was the design, form the solid basis upon which the science has been erected.

Brongniart's fundamental conception was, that fossil plants were none the less plants, and that so fast as they really became known they should be placed in their proper position in the vegetable series and made to form an integral part of the science of botany. In his classification he therefore had due respect for the natural system as then understood, but he nevertheless felt that geognostic considerations must be taken into the account, and he saw with almost prophetic vision that in passing up through the geologic series higher and higher forms of vegetable life presented themselves. Although unable to understand the complete continuity in the series, as modern evolution postulates, and although affected by the Cuvierian idea of successive destructions and re-creations, still he insisted that each successive creation was superior to the one it had replaced, and that there had thus been, as it were, a steady progress from the lowest to the highest forms of vegetation. He divided the geologic series into

four great periods, the first extending through the Carboniferous and corresponding to the modern Palæozoic, the second embracing the Grès bigarré, or Buntersandstein, only, the third seeming to include the rest of the Trias, the Jurassic, and the Cretaceous, and the fourth completing the series. The table which he gives on page 219 of the "Prodrome" is designed to show the development of the higher types of vegetation in successively higher strata, and in discussing it he remarks that "in the first period there exist hardly anything but cryptogams, plants having a more simple structure than that of the following classes. In the second period the number of the two following classes becomes proportionately greater. During the third period it is the gymnosperms which specially predominate. This class of plants may be considered *intermediate between the cryptogams and the true phanerogams* [dicotyledons] which preponderate during the fourth period." The words italicized in the liberal translation here made are scarcely less than a prophecy, and one whose fulfillment is only now being tardily granted by systematic botanists.

As the result of his prolonged studies, Brongniart finally arrived at the following remarkable classification of plants, as drawn up on page 11 of the "Prodrome" and repeated on page 20 of the "Histoire:"

I. Agams.
II. Cellular cryptogams.
III. Vascular cryptogams.
IV. Gymnospermous phanerogams.
V. Monocotyledonous angiospermous phanerogams.
VI. Dicotyledonous angiospermous phanerogams.

In the present state of botanical science Brongniart's "agams" would probably all be relegated to his second group, or cellular cryptogams, but in other respects this classification is preëminently sound, and seems likely to be vindicated by the future progress of science.

It will thus be seen that Brongniart founded the science of vegetable palæontology firmly upon the law of progressive development, and there can be little doubt that if his influence could have been felt by botanists as it was by vegetable palæontologists in general, botany might have advanced *pari passu* with zoölogy. But Brongniart was far in advance of his time, and his views were destined to meet with violent opposition. His method was, with

few exceptions, adopted by subsequent palæo-botanists but never by botanists proper.

The most powerful antagonism to this effort of Brongniart to confirm Lamarckian principles from the phytologic side thirty-one years before the appearance of Darwin's "Origin of Species" was offered by the eminent English botanist, Dr. John Lindley, who found a fitting occasion to meet the great French palæontologist on his own ground while engaged with William Hutton in the preparation of their "Fosssil Flora of Great Britain," 1831–'37. Of this truly great work we are here concerned only with certain discussions which were directed against the then infant doctrine of biologic evolution in the vegetable kingdom, and which were not only marked with great acrimony, but were allowed to influence and to warp the classification adopted by the authors into forms which even to botanists now appear ridiculous. The introductory remarks in the first volume, as well as much of the general discussion throughout the work, are characterized by a most astonishing and apparently willful ignorance of the true principles of palæo-phytology as they were set forth by Brongniart, Sternberg and even Schlotheim, and which are now universally accepted.

One of Dr. Lindley's remarkable aberrations was the pertinacity with which he contended for the existence of cactaceous and euphorbiaceous plants in the coal measures. It is true that Parkinson had seen a fancied resemblance between certain stems and those of large cacti, and similar guesses had been made by Volkmann, Walch and other authors of the eighteenth century, when it was supposed that the counterpart of every fossil plant must be found in the living flora, but all these imaginings had been long since laid aside only to be revived by the leading botanist of Europe.

The theory of a former tropical climate in England and on the continent of Europe was assailed, the existence of tree-ferns in the Carboniferous was denied, the relation of the Calamitæ to the Equisetaceæ questioned, and many other tolerably well established generalizations were remanded to the domain of doubt and discussion.

The true secret of this sweeping skepticism is, however, not far to seek. It is found in the more general denial, which was finally made, of the conclusion to which the acceptance of these

rejected theories would naturally lead and had actually led M. Brongniart and others. The authors say: "Of a still more questionable character is the theory of *progressive development*, as applied to the state of vegetation in successive ages. In the vegetable kingdom it cannot be conceded that any satisfactory evidence has yet been produced upon the subject; on the contrary, the few data that exist appear to prove exactly the contrary." All the denials and assertions made in the work opposed to Brongniart's teachings are made to support this view. The existence of Cactaceæ, Euphorbiaceæ and other dicotyledons in the Carboniferous would negative development; the admission of a former tropical climate was a strong argument for the nebular hypothesis as well as for geologic progress; tree-ferns would argue such a former tropical climate; if Calamites could be shown to be a Juncus, a higher type would be found in Palæozoic strata than Brongniart believed to occur. Still another good point was thought to be gained by proving what is now admitted, viz., that coniferous plants occur in the coal. All botanists then held, as many still hold, that the gymnosperms were a subclass of the dicotyledons, coördinate with the dicotyledonous angiosperms But, curiously enough, Brongniart had forestalled this argument by making the gymnosperms of lower type, intermediate between the cryptogams and the angiospermous phanerogams. By a special insight, characteristic of true scientific genius, he had used their lower geological position as a proof of their lower organization, *i. e.*, had postulated evolution as an aid to organic research—a method which is now becoming quite common, although unsafe except in the hands of a master.

Dr. Lindley laid much stress upon the fact "that no trace of any glumaceous plant has been met with even in the latest Tertiary rocks," thus freely employing the fallacy which he elsewhere warns others to avoid, that because a class of plants has not been found, therefore it did not exist at a given geologic epoch. But to cut off the possibility of a reply to the position he takes he finally declares that "supposing that sigillarias and stigmarias could really be shown to be cryptogamic plants, and that it could be absolutely demonstrated that neither Coniferæ nor any other dicotyledonous plants existed in the first geological age of land plants, still the theory of progressive development would be untenable, because it would be necessary to show that

monocotyledons are inferior in dignity, or, to use a more intelligible expression, are less perfectly formed than dicotyledons. So far is this from being the case that if exact equality of the two classes were not admitted, it would be a question whether monocotyledons are not the more highly organized of the two; whether palms are not of greater dignity than oaks, and Cerealia than nettles." Teleologic and anthropocentric reasoning like this pervades all the discussions in this work and vitiates the scientific deductions. The elaborate experiment that Dr. Lindley made and described in the first dozen pages of the third volume, was obviously animated by the same spirit of uncompromising hostility to the development hypothesis. By showing that the higher types of plants when long immersed in water are earlier decomposed than ferns, conifers and palms, he thought he had demonstrated that the reason why we find no dicotyledons in the Carboniferous is simply because they had not resisted, and from their nature could not resist the destructive agencies to be overcome in the process of petrifaction. One could wish that he might behold the four thousand species of fossil dicotyledons now known, and realize how vain had been his experiment as well as all his theorizing!

It is such resistance as this, coupled with the power of the Jussiæan method, that has retarded the progress of correct ideas respecting the development of plant life. Systems of classification have been chiefly modeled after those of the early founders. The text books of botany still generally invert the order and begin with the phænogams, although this is doubtless merely intended to facilitate study, and does not at all imply that our leading botanists believe this to have been the order in which plants have developed. This inversion of the order, however, shows how completely the notion of development is ignored in modern botany, and the system throughout rests upon the evidence furnished by the organs of the plants as they are understood. Nevertheless, it is proper to say that at the present time quite a large body of the most thorough students of vegetal embryology and histology, chiefly in Germany, have rejected much of the modern system of botanical classification, and especially that which concerns the position of the gymnosperms. They prove in the most satisfactory manner that these plants constitute a lower type than any of the remaining phanerogams, and they

also find that in their reproductive organs they form a more or less natural transition from the cryptogams to the phænogams, between which they place them. This result is most gratifying to the palæo-botanist, for nearly all works on fossil plants give the gymnosperms this position at the base of the phænogamic series, so sagaciously assigned to them by Brongniart. They have been compelled to do this in the face of the prevailing botanical systems, because this is the position which they are found to occupy in the ascending strata of the earth's crust. It is astonishing that botanists could have remained so indifferent to such a weighty fact, and it is certainly most instructive to find the geological record, so long unheeded, confirmed at last by the facts revealed in living plants. There is no evidence that those who have thus confirmed it were in the least influenced by it, since Sachs and Caruel are as silent respecting palæontology as De Candolle or Bentham.

The founders and perfecters of the prevailing system of botanical classification have not been influenced to any marked degree by the idea of development in vegetable life. Few of the earlier ones had ever heard of development, except at least as a visionary theory. This system had become established long before the doctrine of the fixity of species had received a shock, for although Lamarck, himself a botanist, had sown the seed of its ultimate overthrow, still it required half a century for this seed to germinate, and it was during this half century that the Jussiæan system was supplanting the Linnæan and gaining a firm foothold.

Shaking off, for the time being, all fixed allegiance to any system, let us glance for a moment at the lesson which vegetable palæontology now teaches upon the subject of development.

(To be continued.)

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ON THE VERTICAL RANGE OF CERTAIN FOSSIL SPECIES IN PENNSYLVANIA AND NEW YORK.

BY PROFESSOR E. W. CLAYPOLE.

THE Second Geological Survey of Pennsylvania has recently published a report on Montour, Columbia and several other counties, written by Professor I. C. White, of the University of West Virginia. While engaged in the work Professor White requested the writer to determine for him the fossils which he

collected. This was done, and the results were embodied in the volume in question, G_7 of the Pennsylvania reports.

In the preface to the volume Professor James Hall, of Albany, has, through the State geologist, honored the palæontological portion of the work with certain criticisms which call for a few remarks. The science of palæontology advances so rapidly that statements which were perfectly correct at one time often cease to be so, and from this ground, if from no other, the criticisms contained in the preface of Professor White's report require some notice.

I.

It will not be necessary at any length to discuss Professor Hall's first remark concerning the dividing plane between the Chemung and the Catskill. In the present state of our knowledge this must be largely a matter of opinion. One observation will suffice. Whatever may be the fact in Montour and Columbia counties, there is no doubt that in Perry county, with which the writer is better acquainted, spirifers, unbroken and with both valves in contact, are found about 1000 feet above red sandstone beds holding the scales of Holoptychius or Bothriolepis or both.

II.

In regard to the spirifers of the Chemung, certain statements are made which are not in harmony with facts which the writer has observed in Middle Pennsylvania. For instance, on page xx we read:

"How is it possible to credit such a topsy-turvy appearance of the three species of Spirifera which, outside of Pennsylvania, have been found (1) never in any but Chemung rocks; (2) confined each to its own horizon; and (3) always in a fixed order from above downward, thus:

Spirifera disjuncta horizon (*S. dj.*).
Spirifera mesocostalis horizon (*S. mc.*).
Spirifera mesostrialis horizon (*S. ms.*)."

On page xxi we read further:

"*Spirifera disjuncta* and *Spirifera mesostrialis* form an impossible ? conjunction."

This assertion must be, to say the least, somewhat hazardous even with the interrogative point.

Again, on the same page:

"Professor Hall has never seen any two of the three species

coëxisting in the same stratum or at the same horizon or outside the limits of the typical Chemung. He would not be surprised if *S. mesocostalis* were found to ascend high enough above its proper horizon to mingle with *S. disjuncta.* But he cannot comprehend how *S. disjuncta* and *S. mesostrialis* should be found together."

In regard to this point the experience of the writer in Pennsylvania has led him to very different conclusions. So far from being strictly limited to single horizons, these three species appear to range with great latitude over each other's territory. This is especially true of the two lower fossils, *S. mesocostalis* and *S. mesostrialis.* It is no doubt true that each species is specially abundant in certain beds or zones, but while in a measure characterizing these, it spreads both above and below them, and mixes with one or both of the others.

These statements are made concerning Middle Pennsylvania and have no reference to any other district. The writer's experience among the rocks and fossils of New York is not sufficient to enable him to speak with any authority concerning them, and to these it may be supposed Professor Hall is chiefly referring in the passage quoted above.

Since the publication, however, of the report of Professor White, and called forth by its preface, a letter has appeared from the pen of Professor H. S. Williams, of Cornell University, in which, referring to these remarks of Professor Hall, he says:

"While the statement cited may express the general rule as to the occurrence of the species in New York State, there are specimens in Cornell University museum which do not bear out the statement.

"In the first place the two species, *S. mesostrialis* and *S. mesocostalis*, are found associated in the same stratum at Ithaca, N. Y., both in the *mesostrialis* zone and in the *mesocostalis* zone. Several instances can be shown where they occur on the same slab.

"From a higher horizon in New York State, and from several localities, either of these species may be found associated with *S. disjuncta*, and I have obtained each of the three species from the original Chemung locality at Chemung narrows.

"In the museum collection is a small slab containing beautiful representatives of *S. disjuncta* and *S. mesostrialis ;* the latter preserving 'the fine radiate striæ with delicate concentric crosslines' all over the surface of the shell, and with 'the broad median fold without a depression' which are described as distinctive characters of the species (Pal. N. Y., Vol. IV, p. 243).

"The other specimen, only a couple of inches distant, has the characteristic plications on the medial fold, and with the surface equally well preserved, shows not the least trace of radiate or concentric striæ, unmistakably indicating *S. disjuncta.*

"From the same locality, though not on this individual slab, are specimens of both varieties of the so-called *S. mesocostalis*—the large coarse form with angular plications and reduplicated fold, and the more finely plicated form with prolonged hinge line which is more characteristic of a lower horizon."

From these statements of Professor Williams we find that the three following inferences are now known to be true for *New York State:*

1. That *S. mesocostalis* occurs associated with *S. mesostrialis.*
2. That *S. mesocostalis* occurs associated with *S. disjuncta.*
3. That *S. mesostrialis* occurs associated with *S. disjuncta.*

These are all the possible combinations of three things taken two together. Consequently these three species are mingled in New York State in all possible ways in which two of them can be combined.

In order to strengthen, if possible, by cumulative evidence the argument founded on these clear and definite statements, the writer applied to Professor R. P. Whitfield, of New York, asking if the collection of the New York Museum of Science, of which he is curator, could supply any facts that would support the views on the range of these fossils which are here maintained. The greater part of that collection was made and the specimens named by Professor Hall, so that no doubt regarding the identification of the species can be entertained. Professor Whitfield has stated in reply:

1. "On a small block of sandstone containing the specimen of *S. mesocostalis*, figured in the Palæontology of New York (Vol. IV, Pl. XL, Fig. 6), there is an imprint of a part of a very characteristic specimen of *S. disjuncta.*

2. "Another specimen measuring four inches by three, from Schoharie county, N. Y., and bearing Professor Hall's ticket (No. 302), contains one of the specimens of *S. mesostrialis*, figured in the same plate (Pl. XL), and also casts or imprints of three individuals of *S. mesocostalis.*

3. "Another small slab marked, in Professor Hall's writing, 'Tioga county, N. Y.,' contains two dorsal valves of *S. disjuncta* and two ventrals of *S. mesocostalis.*

4. "Another small block, bearing Professor Hall's ticket, shows dorsal valves of *S. mesocostalis* with specimens of the long mucronate hinged form of *S. disjuncta.*

5. "One from Vandermark's creek with large examples of *S. disjuncta* contains a ventral valve of *S. mesocostalis.*

6. "Another bearing Professor Hall's ticket (279), from Cayuta creek, N. Y., has *S. disjuncta* with *S. mesocostalis.*"

Professor Whitfield also adds:

"On one small specimen weighing ten or twelve ounces and bearing the label 'Cayuta creek,' with characteristic specimens of *S. mesocostalis* and *S. disjuncta*, there is an imperfect imprint of the medio-dorsal part of a ventral valve presenting the features of *S. mesostrialis* as it occurs at some western localities [of N. Y.], but its outline is too imperfect to admit of positive identification."

The testimony obtained from the collection in New York, therefore, agrees in every point with that given in Professor William's letter, and suggests in addition the possible association of all the three species at Cayuta creek.

Yet one fact more may be given. Professor H. W. Geiger, of the U. S. Geological Survey, has informed the writer that he possesses a slab from the Chemung of Virginia on which *S. mesostrialis* and *S. disjuncta* are lying side by side.

In the face of these facts it is quite impossible any longer to maintain the sharp delimitation of the horizon of these three species above and below. It is evident that though characterizing, probably in some places by their abundance, certain zones, they are not by any means limited to these zones, but invade each other's territory to an undefined extent.

This result is more in harmony than its opposite with our present views of the progress of life on the globe. We have no reason to believe that species came suddenly into ascendancy and then as suddenly went out, especially at times unmarked by any catastrophe, as was the case in the Chemung era in Middle Pennsylvania and New York. On the contrary, the general belief in evolution involves the special belief that every species has, in ordinary circumstances and barring accident, had its time of rising, culmination and decline, during which its life has overlapped the life of other kindred and perhaps derived species. Nothing is less likely, *a priori*, than that three species of spirifer should lie like three drawers in a geological cabinet one above another. Nothing is more likely than that each should occur in gradually increasing numbers until it reached its maximum, and then in gradually diminishing numbers until it died away. Each may then

distinguish certain horizons, as Professor Hall describes them, but without sharp and decisive limitation to these horizons.

It is farther possible, and not improbable, that these zones of maximum abundance hold the same relative positions to one another in New York and in Pennsylvania. This, however, must be decided by closer study. Nothing that the writer has seen or published is antagonistic to such belief. But even if the zones of maximum abundance should not hold the same relative positions to one another in different parts of the country, we are not driven to the alternative of asserting a "subversion of specific types in vertical range" (p. xxvi). Given the three species, or indeed any two of them, living side by side through the greater part of the Chemung era, and we need only admit that local conditions favored here the one and there the other, and the whole difficulty disappears. It is purely imaginary. It is scarcely probable that identical conditions of life existed contemporaneously over so great an area, it need not consequently shake our belief in palæontology if the result should show that in Pennsylvania and Virginia, or in States still more distant, the zones of maximum abundance hold an order different from that which Professor Hall has laid down for New York.

Another fact may be mentioned in this connection which, though not directly connected with the argument, yet serves to show that the lines of delimitation bounding the range of fossil species cannot be laid down as definitely as has been done by some palæontologists. *S. lævis* is one of the characteristic fossils of the Portage group in New York State occurring neither above nor below, so far as the writer is aware. Yet in Middle Pennsylvania it has not been found in the strata occupying the position of the Portage of New York, and holding other Portage fossils. But it does occur higher up, in the Chemung proper, and in company with *S. mesocostalis*.[1] *S. lævis*, it may be added, is a well characterized species in New York, and is therefore readily recognized.

III.

Passing on to another topic, we find on page xxii:

"*Orthis tulliensis* has certainly never been seen before in the Chemung two hundred feet above the Genessee (*i. e.*, three hundred feet above the Tully limestone), nor in the company of *S. mesocostalis*."

[1] This is possibly *S. mesostrialis*. The specimen is only a fragment.

This statement may be strictly true, but it may be urged, on the other side, that there is no distinct character by which *O. tulliensis* can be separated from *O. impressa*. No doubt two forms can be picked out as types of the so-called species, but their variation is considerable and they run into one another. It would be exceedingly difficult, perhaps quite impossible, to separate accurately a mixture of the two species if the horizons of the specimens were unknown. We seem here to have an example of a vicious reasoning of which palæontology affords not a few similar instances. The Orthis from the Tully limestone is called *O. tulliensis;* that from the overlying Chemung is called *O. impressa.* But barring this difference it would be hard to draw a line between them. The practice of giving different names to fossils simply because they come from different horizons has been carried too far. It has created artificial barriers in the way of tracing the evolution of species and the connection of strata. Neither geological nor geographical separation is sufficient reason for distinguishing by name fossils between which no clear structural difference can be pointed out. The cases are few, especially among the Testacea, that justify resort to the argument used by the late Professor Meek, "that if the whole structure of the animal had been preserved doubtless some distinctions would be found which do not exist in the fossil."

Referring to the extract given above from the preface of G_7, Professor Williams says in the letter already quoted:

"In regard to *Orthis tulliensis* it may be said that the common Orthis occurring at the base of the Ithaca fauna within a few hundred feet above the Genessee shale (less than 500) resembles at its first appearance *Orthis tulliensis* in form and general character, though for distinctness it may be appropriate to call it a variety of *Orthis impressa*, since a little higher and in the same fauna the typical *Orthis impressa* appears in abundance.

"Still there are specimens in the collection, from the lowest zone, which it would be difficult for any one to distinguish by microscopic or macroscopic characters from *O. tulliensis*."

There is therefore *in New York* an Orthis which cannot be distinguished from *O. tulliensis*, occurring not at 200 feet only, but at a yet greater height (less than 500 feet) above the Genessee shale.

In regard to the association of this fossil with *S. mesocostalis*, Professor Williams adds:

"I have no single slab containing this form with *S. mesocostalis*,

but the latter is found both above and below the stratum containing the Orthis."

IV.

Reverting to the preface of G_7, we read on page xxii this remark, apparently by the State geologist:

"*Halysites catenulatus* [the common chain-coral] is found quite out of its natural place; at one locality only it is true, but in such abundance as to make up a large proportion of the twenty feet of beds through which it is found."

"'Sir W. E. Logan recognizes it as low as the *Trenton limestone*, and I have seen a form or variety of the same in the *Hudson River group* of Green bay,[1] but no one has ever before found it above the Niagara.'"[2]

Professor Lesley adds very justly:

"Whatever may be the difficulty of distinguishing *S. disjuncta* from *S. mesostrialis*, it is quite impossible for any one to mistake *Halysites catenulatus*, the characteristic form of the *Niagara limestone* all over the United States and Canada, and also of the corresponding *Wenlock* of Europe.

In these passages there are obvious traces of the vicious reasoning already condemned. The "natural" place of a fossil is surely that in which it is found. Its "canonical" place may be very different. Now of the occurrence of *Halysites catenulatus* in the Lower Helderberg limestone at the place mentioned by Professor White, there cannot be the slightest doubt. The obvious character of the fossil, such that every tyro in palæontology is acquainted with it, precludes all chance of mistake in its identification. The position of the limestome bed in which it was found is equally decisive against stratigraphical error. It overlies several hundred feet of red shale and sandstone, which are the equivalent of the Onondaga shales of New York—the Salina shale or Salt group, as they are often called.

The correlation of these has been satisfactorily determined in Middle Pennsylvania, and the evidence, both stratigraphical and palæontological, may be seen in the writer's report on Perry county (F_2). It is proper to add here that the above statement concerning the place of the bed is made from personal knowledge, the ground having been visited for the purpose in company with Professor White.

[1] Some inconsistency exists between this statement and that on p. xxv. "Professor Hall has given himself infinite trouble to obtain the data on which rests the proof that *H. catenulatus never* occurs except in *Niagara* and *Clinton* rocks."

[2] Letter from Professor Hall.

Immediately above the limestone bed in question comes the Oriskany sandstone, so that the evidence for position is rendered doubly sure, and it would be idle, in the face of all the facts, to entertain any remaining doubt or suspicion regarding the horizon or the species of the fossil. It is *Halysites catenulatus*, and it is found in the Lower Helderberg limestone.

Halysites catenulatus ranges in England from the Llandeilo up to the Wenlock, and in America from the Trenton to the Niagara, by consent of all geologists. At this horizon its disappearance has been assumed. But the determination here maintained carries it up through about 1200 feet of strata, and extends its specific life through a correlative lapse of time.

In the consideration of these facts it may be remarked that the very ease and certainty with which this fossil can be recognized appear to the writer a possible source of error. Being abundant at numerous places in the Niagara limestone, it forms a convenient fossil reference, and its range has been, by tacit consent and perhaps with the aid of influential names, assumed to be limited upward by the summit of the Niagara. It has thence become the practice to refer all strata containing it to the Niagara group, and the two have become closely associated. Yet the foundation for so strict a delimitation is as unsatisfactory as in the cases previously examined. It is in fact another instance of vicious reasoning. *Halysites catenulatus* occurs very frequently in Niagara rocks, therefore all rocks yielding *Halysites catenulatus* are of Niagara age.

If this fallacy be avoided and the upward range of Halysites be admitted, its occurrence in the place and on the horizon mentioned by Professor White (in G_7) instead of being " a serious matter for Pennsylvanian geology " (p. xxiii), may be a matter of importance to the geology of some States outside of Pennsylvania, and may even cause the removal to a higher level of some strata which have been hitherto placed in the Niagara group by the hasty deduction above condemned.

For example, it is just possible, to say no more, that the occurrence of this fossil in the cement beds, as at Kingston, N. Y., may be hereby explained. If these cement beds are the same as those usually included under that name, they should lie in the Lower Helderberg series and not in the Niagara, as often stated. Moreover a reference to Professor Hall's geological map of New

York State (Geol. N. Y., Vol. IV, 1843), and also to that of the Geological Survey of Canada, 1863, will show that no outcrop of the Niagara is represented within a hundred miles of Kingston, the color representing that group ceasing near Utica, while the Lower Helderberg continues and underlies the town. It is hard to resist the conclusion that we have here an instance of correct stratigraphy overruled by incorrect palæontology, and that so far from its occurring only in the Niagara this is an example in *New York State* itself of the occurrence of Halysites in the Lower Helderberg limestone.[1]

V.

From the facts and arguments here set forth the general conclusion must follow that all attempts to confine the range of species within certain arbitrary lines are attempts that are not likely to succeed. The geological record as written in the rocks is a record of life. Evolution teaches us that life advanced by slow stages from species to species; that as one died out another took its place. Evolution knows nothing of breaks or of hard and fast planes of limitation in the range of species. All such planes are indications of imperfection in the geological record, perhaps evidence of catastrophes on a small scale, but they are no proof of widespread disaster and destruction. And in proportion to the advance of our knowledge we must expect, on the principles of evolution, to see these breaks one by one disappear, and these lines be one after another effaced until the record of the rocks is in harmony with the record of life which it represents. That this harmony will ever be perfect is unlikely, for the rocks will never give up all their dead, but that it will one day be much more nearly complete than now is axiomatic, in the face of the continual discovery of missing chapters in the history supplying missing links in the chain of life.

The artificial systems of palæontology which have been constructed by the faithful, earnest and devoted labors of the students of the science are but temporary. They are invaluable aids to the progress of the work, but they are only the means and not

[1] On p. xxiii (G_7) an error appears which causes some confusion. "*S. macropleura* is the earliest spirifer which shows ribs in the medial series (sinus ?), and it recurs nearly unchanged in the Subcarboniferous Chester limestone of the West." *S. macropleura*, as may be seen by looking at Professor Hall's figures (Pal. N. Y., Vol. III, Pl. 27), has no ribs in the medial sinus. Nor does it recur nearly unchanged in the Chester limestone of the West.

the end. Progress will be hindered if these systems are allowed to cramp and fetter us. If preconceived notions of what *should be* are suffered to blind our eyes to what really *is*, our palæontology would itself become a fossil, as dead as the trilobites of palæozoic days. Our subdivision of the geological column into Hamilton, Chemung, Catskill, &c., or even into Cambrian, Silurian and Devonian, &c., is simply a device to assist memory and classification, not to represent actual and separate creations. And with every new discovery we must expect to see the lines and planes that separate these imaginary groups and systems become less and less clear until they are fused into a whole whose parts shade into one another like the colors of the rainbow. Nature is larger than our systems, and our knowledge of fossil nature must some day outgrow our artificial "canons of palæontology." But in all such cases nature cannot be warped to our "canons," our "canons" on the contrary must bend to the facts of nature.

The writer cannot conclude without, superfluous as it may seem, adding a word to express his sense of the value of the labors of Professor James Hall in American palæontology. He has laid broad and deep foundations for future workers. How numerous or industrious soever they may be, they must always acknowledge that they are building over his beginnings. That some errors should creep into work so great and varied is to be expected. But compared with the grand whole, they are insignificant. In pointing out and correcting a few of these errors in the foregoing pages, nothing is farther from the writer's wish than to seem to depreciate Professor Hall's labors. The facts and misstatements here criticised are mainly details—mere spots on the face of the sun—but for that reason the more worthy of attention and scrutiny.

——:o:——

ANCIENT ROCK INSCRIPTIONS ON THE LAKE OF THE WOODS.

BY A. C. LAWSON, M.A.

WHILE prosecuting a geological survey of the Lake of the Woods last summer, I observed upon the rocks, at two places not far distant from each other on the shores of the lake, ancient inscriptions which may be of some interest to those who are engaged in gathering up and weaving together the scattered

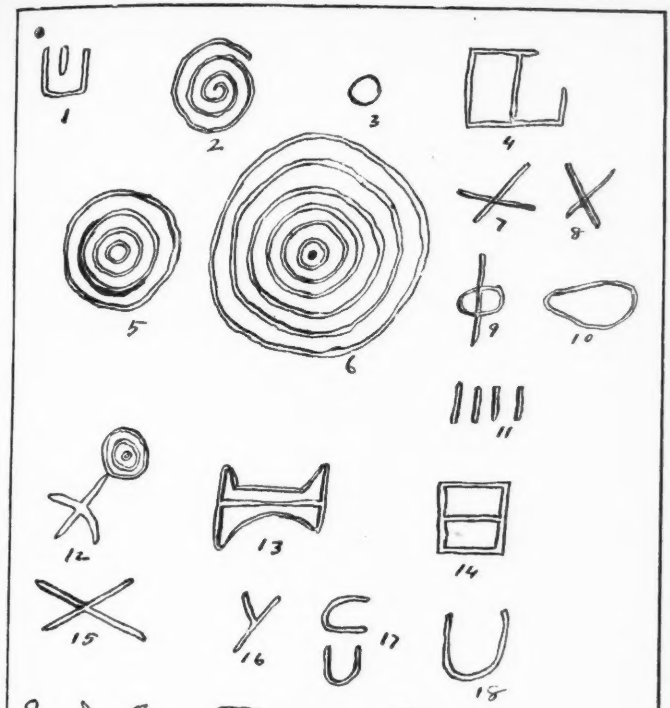
threads of evidence, which in the web display the checkered life-history of the aboriginal peoples of the American continent. I am induced to publish this note on the subject at present, rather than wait for further opportunities of collecting additional material, because of the striking resemblance which some of the characters of these inscriptions bear to those of certain Brazilian rock inscriptions figured by Mr. John C. Branner in his interesting paper in the December number of the AMERICAN NATURALIST.

The Lake of the Woods is divided about its middle into two parts, a northern and a southern, by a large peninsula extending from the neck of land at Turtle Portage on the east side of the lake to within a very few miles of the west shore. On the north side of this peninsula, *i. e.*, on the south shore of the northern half of the lake, about mid-way between the east and west shores, occurs one of the two sets of hieroglyphic markings to which I refer. The more typical examples of these are figured in Plate XIX. Lying off shore at a distance of a quarter to half a mile, and making with it a long sheltered channel, is a chain of islands trending east-and-west. On the south side of one of these islands, less than a mile to the west of the first locality, is to be seen the other set of inscriptions. The first set occurs on the top of a low, glaciated, projecting point of rock which presents the characters of an ordinary *roche moutonnée*. The rock is a very soft, foliated, green, chloritic schist into which the characters are more or less deeply carved. The top of the rounded point is only a few feet above the high water mark of the lake, whose waters rise and fall in different seasons through a range of ten feet. The antiquity of the inscriptions is at once forced upon the observer upon a careful comparison of their weathering with that of the glacial grooves and striæ, which are very distinctly seen upon the same rock surface. Both the ice grooves and carved inscriptions are, so far as the eye can judge, identical in extent of weathering, though there was doubtless a considerable lapse of time between the disappearance of the glaciers and the date of the carving. The ice grooves are not merely local scratches but part of the regular striation which characterizes the whole region. Both the striæ and inscriptions present a marked contrast to some recent letters which passing traders or travelers, attracted by the novelty of the inscriptions, have cut into the rock, much in the same spirit as that in which my Christianized Indian canoe-man pro-

ceeded to carve his initials in the rock with my hammer the moment we landed. The weathered and rough character of the carving afforded no clue as to the tool used. In size the characters varied from about three to twelve inches. There was no indication of ochre having been rubbed into the carving. The characters figured in Plate XIX were scattered over the rock surface in all directions and in greater numbers than are represented; and although the typical ones are gathered together on one sheet, that arrangement by no means shows their relative positions. The chief advantage to be derived by archæologists from an acquaintance with such inscriptions is the tracing out the similarity or identity of the individual characters with those of inscriptions found in other parts of the continent. There is little hope of any coherent meaning or narrative ever being derived from such isolated groups of characters.

The similarity of some of the characters now figured to those described by Mr. Branner from the boulders of Alagôas is a striking and suggestive one. For example, No. 2, Plate XIX, is identical with the left-hand figure of Mr. Branner's *h*, even as to the number of whorls and their direction. No. 25 is almost identical with *a* and *b* of Mr. Branner's plate. The horse-shoe or part-circle shape is distinctly common to both, as may be seen by comparing *X* and *d* of the Brazilian inscriptions with 17, 18, 21, 23, 24 and perhaps 29 of those from the Lake of the Woods. Nos. 7, 8, 15, 20 may be compared with Mr. Branner's asterisk as simpler forms on the same principle. The circle is also common to both sets. Nos. 1, 4, and 14 are similar in character to the 3d form from the top of Mr. Banner's *X*. No. 10 has nearly the same shape as the 3d on the top row of the same group. No. 12 is not unlike Mr. Branner's *c* and No. 19 is on the same principle as the chain of small circles of his *f*. But there is no need of straining the comparison. The coincidence appears to be too strong to be purely accidental, although considering the remoteness of the two regions in question, much more abundant material for comparison would be required before inferences, even of the most general sort, could be drawn.

The island on which were found the other inscriptions to which I have alluded, is one of the many steep rocky islands known among the Indians as *Ka-ka-ki-wa-bic min-nis*, or Crow-rock island. The rock is a hard greenstone, not easily cut, and the



Indian Inscriptions, Lake of the Woods.

inscriptions (Fig. 1) are not cut into the rock but are painted with ochre, which is much faded in places. The surface upon which the characters are inscribed forms an overhanging wall protected from the rain, part of which has fallen down, cutting off the inscription sharply at 6. The characters are represented in their relative positions as they appear on the rock surface,

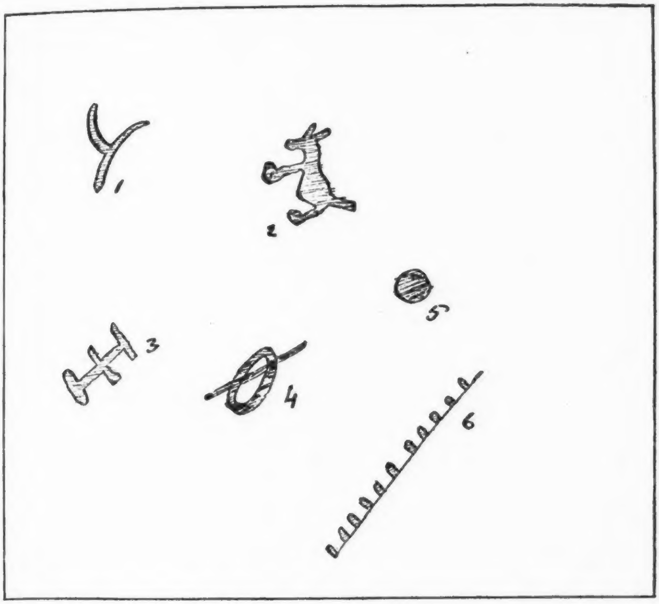


FIG. 1.—Indian Inscriptions.

reduced about ten times. Two of the forms, viz., 1 and 4, have a sufficiently strong resemblance to 16 and 9 respectively of Plate XIX, although one is in ochre and the other carved into the rock, to lead to the belief that the two inscriptions are closely related in authorship. The Indians of the present day have no traditions about these inscriptions beyond the supposition that they must have been made by the " old people " long ago.

KITCHEN GARDEN ESCULENTS OF AMERICAN ORIGIN. III.

BY E. LEWIS STURTEVANT, M.D.

(Continued from p. 553, June number.)

Pumpkins and Squashes. — In New England's Annoyances, Anon., 1630, the first recorded poem written in America, we find:

> "If fresh meat be wanting to fill up our dish
> We have carrots and pumpkins and turnips and fish.

Again:

> "Our pumpkins and parsnips are common supplies:
> We have pumpkins at morning and pumpkins at noon:
> If it was not for pumpkins we should be undone."

And:

> "For we can make liquor to sweeten our lips
> Of pumpkins and parsnips and walnut tree chips."

And the pumpkin has ever been considered a favorite vegetable for the making of pies in New England, and the various squashes form an appreciated vegetable.

Pumpkins and squashes seem to be of American origin, although De Candolle[1] says "it may be confidently asserted that the pumpkins cultivated by the Romans and in the middle ages were *Cucurbita maxima*, and those of the natives of North America, seen by different travelers in the 17th century, were *C. pepo.* There are no figures of the pumpkin in the Herbarius Bataviæ Impressus of 1485, before the discovery of America, yet it is frequently figured by botanists of the 16th century." Anton Pinæus[2] figures the bottle gourd, or Lagenaria, under the name of *haraha* or *hara* or *charha* of the Arabs, *zucca* of the Italians, *kurbss* of the Germans, *calabassa* of the Spaniards, *courge*, *courle* or *causse* of the French. His figure of the pumpkin is called *Cucurbitæ indianæ* and *peregrinæ*, *zucche Indiane* of the Italians, *courges d'yuer* of the French, which indicates how the old world names were applied to new world resembling productions, with the origin prefix which soon became dropped.

One of the confusing elements in the research into the history of plants is the absurd use of common names, and often the inapplicability of the term used to express resemblance if interpreted in other than the most general sense. Thus Ludovico de

[1] Origin of Cult. Pl., 256.

[2] Hist. Plant., 1561.

Varthema, 1503–8, mentions a fruit called *camolango* in India, which is unquestionably *Benincasa cerifera* Savi, as "resembling a pumpkin."[1] Now as a matter of fact this cucurbit, as grown at the New York Agricultural Experiment Station, resembled a watermelon so perfectly that it was plugged by thieving boys, and until its waxy coating was acquired, could deceive visitors who did not notice the leaf. Early voyagers to America, as Gray states:[2] "Wrote *cucurbita. calabaza*, *courge* or *zucca* as a name for any gourd or pumpkin, and occasionally for a calabash which was not even a cucurbit;" and translators have been equally as indefinite in their interpretation of the original word used by their authors. It seems useless, therefore, to add the testimony of travelers of the sixteenth century, and which are not quoted by De Candolle[3] and by Gray and Trumbull,[4] for to those who would deny the accuracy of the vernacular names used, such transcripts would not be convincing. A most valuable argument, however, is the absence of certain identification of this class of plants with the names used by authors preceding the discovery of America,[5]

[1] Travels, Hak. Soc., v, 32.

[2] *Am. Jour. of Sc.*, May, 1883, 371.

[3] Geog. Bot. and Origine des Cult. Pl.

[4] *Am. Jour. of Sc.*, May, 1883.

[5] The Cucurbita of the ancients was either Cucurbita, or Lagenaria, or Benincasa of modern botanies, a proposition to which all investigators will agree. The authors which I have at hand are Columella, Pliny and Palladius, covering the first and third century of the Christian era. From their writings we can infer two propositions. First, it could be a Lagenaria; second, it could not be *Cucurbita maxima*.

Columella lays especial stress upon the "neck" (lib. x, v, 380–389); in verse 234 he uses "*fragili* cucurbita *collo*" as a distinguishing term; in verse 380 he uses the word *prægnans*, which finds explanation in verse 384. His directions for planting (lib. xi, C. 3) applies equally to pumpkins or gourds, but the stress laid upon the uses indicate a gourd, and a gourd only of our known plants; as a food plant he scarcely notices it. This small use of the Cucurbita of the ancients as a food, finds countenance from Apicius, who treats of them (lib. iii, C. 4) as a vegetable, but adds to the dish pepper, cumin, silphium, rue, fish sauce and vinegar in order to make them palatable. At the present time, according to Vilmorin, the Lagenaria is eaten, while young, in the manner of a squash, but is usually grown for ornament. These characters, as given by Columella, all apply to *Lagenaria vulgaris*, and not to *Cucurbita maxima*. Palladius (lib. iv, C. 9) describes the *neck* or *bottle form*, and the uses as utensils, and does not indicate their use as food. Pliny (lib. xix, C. 23) describes a fruit called *melopepo*, shaped like a quince and of recent introduction. His reference to color, *odor*, and their *dropping from the stalk when ripe*, would seem to indicate our melon. In lib. xix, C. 24, he speaks of the climbing habit of the Cucurbita of one kind, and the weight of the fruit so heavy that the wind does not move it, and yet attached to a small stalk; of variable shape, sometimes long like a ser-

and the frequent descriptions and mention by botanists and travelers after the discovery of America.

Naudin, the authority on this genus, refers all the forms of the cultivated pumpkins and squashes to four species, *Cucurbita maxima*, *C. pepo*, *C. moschata* and *C. melanosperma*. The three first forms of these are in French culture, and Vilmorin describes thirty-two varieties.[1] Of the eighteen varieties under *C. maxima*, eight have their American origin indicated by name or statement; of the five varieties under *C. moschata*, two have American names; of the nine varieties under *C. pepo*, three have an American origin indicated by name. The historical record does not seem to change this numeration in such a way as to indicate that *C. maxima* is more native to Europe than is *C. pepo*. We may, however, trace the appearance of such forms of this vegetable as we have data for, and we shall find that America has contributed very largely to the varieties.

The word *pumpkin* seems to have been transferred to our cucurbits from the Greek *pepon*, "a gourd or melon not eaten till quite ripe," Aristoteles,[2] or the Latin *pepo*, "a species of large melon or pumpkin, Pliny,[3] but the word does not occur in Scriptores Rei Rusticæ veteres Latini of Gesner, which indicates how little known was the *pepo* in Italy where now the pumpkin is so common, and where it so early appeared after the discovery of America. The word *squash* seems to have been derived from the

pent, even, says our chronicler, occasionally nine feet long. He evidently refers next to the Benincasa, which he has confounded with the gourd, for he says it is covered with *a white bloom*, especially as it grows large. There is not a word here to indicate a pumpkin of any kind; the whole wording may apply to *Lagenaria vulgaris* in its varieties, except the last, which fit *Benincasa cerifera*. To one who will read Columella, Pliny and Palladius with Vilmorin's Les Plantes Potageres in hand, the references of our authors will be seen to apply very closely to the Lagenaria varieties figured therein; sufficiently so for a clear identification, taken with the context; and to apply *not at all* to any of the Cucurbita varieties therein figured and described under *Cucurbita maxima*.

While upon Latin authors we will take occasion to note that neither Columella nor Palladius reckon the *faseolus* or *phaseolus*, which some writers have taken to be kidney-beans, among garden plants, but class with field crops, and Virgil classes with the vetch as a cheap food. The directions for planting are to sow the seed, six pecks per acre, in the autumn. Hence their *faseolus* must have been a hardier plant than our kidney-bean, and *not* our bean. Apicius' receipt for cooking and Pliny's mention would apply equally well to a Dolichos as to a Phaseolus.

[1] Les Pl. Pot., 171–186.

[2] Liddell and Scott's Greek Dict.

[3] Andrews' Lat. Lex.

New England Indian "*Askutasquash*—their vine-apples—which the English, from them call squashes,"[1] or *isquotusquashes*,[2] or "*squashes*, but more truly *squoutersquashes*,"[3] or from the New York Indian *quaasiens*.[4] The first vernacular use of the word *cymling* used to designate a form of bush squash (also called *pattypan*, probably from its shape, the word *pattypan* signifying "a pan to bake a little pie in"),[5] that I find is in 1648, when *symnels* and *maycocks* are enumerated among other edible products of the region at the mouth of the Susquehanna.[6] In New England's Crisis, a poem by Benjamin Thomson, in 1675, we find:

> "When Cimnels were accounted noble blood,
> Among the tribes of common herbage food."

The word *cushaw* is Indian, and is derived from *ecushaw* of Heriot, 1586. It was applied to a bluish-green, white-streaked large pumpkin by Beverly,[7] and the description applies to the Puritan squash of Burr, and also to a Florida squash grown at the N. Y. Agr. Exp. Station, in 1884, from seeds obtained from the Seminoles in Florida. The word *cuckaw* is now used as a synonym of the winter crookneck of New England, and *cushaw* or *cashaw* to a Southern form of like character, both of which have two forms, one of which is the form of the *Puritan* and *Neapolitan* grown at Naples, the other crooknecked. It is interesting to note that *courge de la Floride* is a French synonym of the Neapolitan.[8]

The popular grouping of this class of vegetables does not conform to the scientific. Gregory[9] offers the definition in use: "Grouping all the running varieties together, we express the marketman's idea of a *squash*, as distinguished from a *pumpkin*, when we say that all varieties having soft or fleshy stems, either with or without a shell, and all varieties having a hard woody stem, and without a shell, are *squashes*. While all having a hard stem and a shell, the flesh of which is not bitter, are *pumpkins:* and all of this latter class the flesh of which contains a bitter

[1] Roger Williams' Key, &c., 222.
[2] Wood, New Eng. Prosp., Pt. 2, Chap. VI.
[3] Josselyn's Rar., 89.
[4] Van der Donck, Desc. of New Netherlands, 1656.
[5] Webster's Dict.
[6] A Desc. of New Albion [1648].
[7] Hist. of Va., 124.
[8] Vil., Les Pl. Potag.
[9] Squashes, p. 4.

principle, are *gourds*." An examination of a more complete set of varieties than the marketman uses, however, shows that this classification is not always correct. The popular use of the terms seem to be, *squashes* are those forms used on the table; *pumpkins* those forms that are grown for stock and for use in pie making; *gourds* are *Lagenaria vulgaris*, and have white flowers. It is thus seen that the popular word as used now would be as misleading as are the popular words used by the early explorers.

De Candolle is willing to grant that *C. pepo* is American, but is uncertain about *C. maxima*. He says, however, that seeds, certified by M. Naudin to belong to this species, have been found in the tombs of Ancon, a conclusive circumstance if the date of the latest burials at Ancon were certain. The Brazilians had, however, a name for this plant, *jurumu*,[1] and Pickering[2] quotes a Carib name, *jujuru* or *babora*,[3] but Schomburgh[4] gives *aboboras* as the Brazilian name of *C. pepo* L. It is the *Pepo maximus indicus compressus* of Sloane (1707), *Cucurbita pepo* Aubl. Sloane's name being the same as used by Lobel, 1581 (?).[5] In traditionary relations the large pumpkin appears in Mexico, for Bancroft[6] says: "In the golden age of Mexico, during the reign of Quetzalcoatl, pumpkins were said to measure a fathom round." Pickering[7] says that "melones" too large for a man to lift, some of them internally yellow, were noted by Oviedo[8] in the West Indies. The "mammoth" squash belongs to this section, and Loudon records a weight attained of 245 lbs., and a "mammoth chili" was exhibited in New York in 1884 by a seedsman, which weighed 223 lbs. In 1857 one weighing 264 lbs. was exhibited at the California State Fair, and one weighing 313 lbs. is said to have been shown at the Smithfield Club Cattle Show in Liverpool.[9] Messrs. Asa Gray and J. Hammond Trumbull[10] seem to have offered sufficient reason to believe that all the pumpkins and squashes are of American origin. I may only add therefore some horticultural evidence.

[1] Piso. Brazil, ed. 1658, 264; Marcq., ed. 1648, 44.

[2] Chron. Hist. of Pl., 709.

[3] Desc.

[4] Hist. of Bar., 593.

[5] De Candolle, Geog. Bot., 901.

[6] Native Races, III, 241.

[7] l. c.

[8] Nat. Hist., 80.

[9] Vick's Month., 1881, 51.

[10] *Am. Jour. of Sc.*, May, 1883,

In 1828 five varieties of "pumpkin," three of squash and two of summer squash were offered in our best seed catalogue, one of which was the Commodore Porter Valparaiso, brought from Chili by Com. Porter, and representing *C. maxima* in the list of *squashes.* In 1885, in one seed catalogue five varieties of *pumpkin,* twelve varieties of *squash* and four of summer squash; of these *squashes* seven belong to *C. maxima,* and the Valparaiso is not included. The Hubbard is said by Gregory, its introducer, to be of unknown origin, but to resemble a kind which was brought by a sea captain from the West Indies; it was distributed in 1857. The *marblehead* came from the West Indies, and was distributed about 1867;[1] the autumnal marrow or Ohio appeared in 1832; the Butman in 1875. Not one variety of this class seems to have originated in Europe, although *pumpkins* of this species are found there in numerous forms, but most of them in general characters of form of fruit can be duplicated from the varieties of traditionary origin in New England. Vernacular names count for little, but the *citrouille iroquois* applied to a French pumpkin of this species would add support to the traditionary belief that pumpkins of like nature formerly existed among the Northern Indians. Molina, 1787,[2] mentions "the yellow flowered or Indian gourd, called *penca;* it is of two kinds, the common and the mamillary This last in its leaves and flowers resembles the first, but the figure of the fruit is spheroidal, with a large nipple at the end; the pulp is sweet, and its taste is very similar to a kind of potato known by the name of camote," a description which will only apply to the varieties of the squash of the turban character.

It would seem as if the burden of proof was upon botanists to show the Asiatic origin, or a knowledge of the pumpkin and squash before the voyage of Columbus, before rejecting the American evidence as inconclusive.

Purslane. — Gray and Trumbull are inclined to believe that Purslane was in the new world at the time of the discovery. Oct. 28, 1492, Columbus saw "verdolagas" on the north shore of Cuba.[3] Oviedo, writing about 1526, enumerates among native plants of Hispaniola "verdolagas and pertulaca," and in 1525 mentions the abundance of "verdolagas." Jean de Lery in Bra-

[1] Gregory, Squashes, 1867.

[2] Hist. of Chili, I, 93.

[3] Navarette, I, 183.

zil, 1557, mentions "pourpier." Sagard-Theodat, speaking of the country of the Hurons, speaks of *pourpier* or *pourcelaine* being a common weed of their cornfields. These quotations are from Gray and Trumbull's article, *Am. Jour. of Sc.*, April, 1883.

Champlain, in 1605, speaking of the Indians of the Maine coast: "They brought also some purslane, which grows in large quantities among the Indian corn, and of which they make no more account than of weeds."[1] Josselyn, about 1672, speaks of it in Massachusetts,[2] and Cutler, 1785, mentions it in cornfields, and as eaten.

Hawkins, 1593, at Cape Blanco, So. America, found upon the rocks "great store of the hearbe purslane," which he collected for the refreshment of his sick.[3]

While it is not certain that these authorities all meant *Portulaca oleracea* in their mention, yet it would appear very strange if such a common weed of cultivated lands of the old world had not been well known and recognized.

Purslane, in one variety, yet finds sale among the seeds of our seedsmen among potage herbs.

Claytonia perfoliata Don. is called in France *Claytonia de cuba*, and pourpier d'hiver; in Spain *verdolago de cuba*.[4]

Sweet Corn.—All the forms of maize are of American origin. The early history of the sweet or garden form-species is very obscure, although the peculiar appearance and rich edible quality of its sweet kernel would presuppose quick and flattering recognition from the first comers.

Sweet corn is said by some to have been brought by Lieut. Richard Bagnoll from Gen. Sullivan's expedition against the Six Nations in 1779, and to have been called *papoon corn*. The anonymous writer in the New England *Farmer* (Sep. 7, 1822) under the pseudonym "Plymotheus," says: "That was the first of the species ever seen here, and since that time it has been more and more diffused; and I believe within a few years only, has been generally and extensively cultivated for culinary purposes." In another communication (Aug. 3, 1822) it is said to have been found during Sullivan's expedition "among the Indians on the border of the Susquehanna." Another account[5] says it was found by Sullivan's

[1] Voy. Prince Soc. ed., 75.

[2] Rar., 81.

[3] Hawkins' Voy., Hak, Soc, ed., 137.

[4] Vilmorin, Les Pl. Pot., 157.

[5] Loudon's Gard. Mag., VI, 483.

command in the Genesee country in 1779, and brought to Connecticut, whence it proceeded south.

Sweet corn is neither mentioned nor hinted at in Jefferson's Notes on Virginia, written in 1781. Timothy Dwight applied the synonym "shriveled corn," usually called "sweet corn," and says that "maize of the kind called sweet corn was the most delicious vegetable while in the milky stage of any known in this country. At New Haven the sweet corn may be had in full perfection for the table by successive plantings from the middle of July to the middle of November.[1] Dwight traveled in New York and in New England in 1817 and before, and was in Yale College in 1795. (This quotation was contributed to me by O. P. Hubbard, New York.) Bordley[2] says: "It has appeared to me that the sort called *sweet corn* (having a white shriveled grain when ripe) yields stalks of richer juice than the common corn."

Sweet corn is first mentioned for sale, so far as we have seen, in Thorburn's seed catalogue of 1828, one kind only, the *sugar* or *sweet* being named. It is not spoken of by name even in his Gardeners' Kalendar for 1817 or 1821, nor in M'Mahon's American Gardeners' Calendar, 1806, nor by Gardiner and Hepburn, 1818, nor in a Treatise on Gardening,[3] 1818, nor in Fessenden's New American Gardener, 1828. In 1829 several ears of a "new variety" from Portland, Me., were exhibited before the Massachusetts Horticultural Society. Bridgeman mentions one variety in 1832; Buist, in 1851, speaks of two varieties, but Salisbury, 1848,[4] describes three, and Bement,[5] 1853, two sorts. In Schenck's Gardener's Text-book, 1854, three varieties are named. In 1863 Burr describes nine, and in 1866, twelve sorts. In an illustrated article of my own, contributed to the *Rural New Yorker* for 1884, thirty-five varieties are described as distinct, and thirty-two are figured.

Sweet corn is not mentioned in Noisette's Manual Compleat du Jardinier, 1829, not by Bonafous in his folio work published in 1836, so we may assume it had not reached French culture at the latter date. In 1883 Vilmorin names seven sorts, all of which are American named.

[1] Travels, 1821, I.
[2] Husbandry, 1801,
[3] John Randolph.
[4] Trans. N. Y. Ag. Soc., 1848, 836.
[5] ib., 1853, 336.

Sweet Potato.—We do not hear of the sweet potato until after the discovery of America.[1] Clusius,[2] in 1566, first saw them in Spain,[3] and Oviedo records their introduction from the West Indies. Ramusio's Collection of Voyages was published 1563-74, and in the Portuguese pilot's relation, therein published, is, "The root which is called by the Indians of Hispaniola *batata*, is named *igname* at St. Thomas [coast of Africa], and is one of the most essential articles of their food."[4] The igname was mentioned at St. Thomas by Scaliger, 1566. It was grown by Gerarde in England in 1597, and is figured by Rheede as cultivated in Malabar, and by Rumphius in Amboyna, the latter asserting that they were brought by the Spanish Americans to Manilla and the Moluccas, whence the Portuguese diffused it through the Malay archipelago. In China Bretschneider tells De Candolle[5] that according to the Chinese books the sweet potato is foreign to China, and that the *Min-shu* published in the sixteenth century, says that the introduction took place between 1573 and 1620.

In America they are noted by many of the early voyagers, from Columbus onward. Asa Gray and Trumbull, *Am. Jour. of Sc.*, April, 1883, have collected the evidence. We may add to their references that Chanca, physician to the fleet of Columbus, in a letter dated 1494, speaks of *age* or sweet potatoes or yams as among the productions of Hispaniola,[6] and Pigafetta Vicentia, 1591, found in Brazil *batatas*, "they resembled turnips and tasted like chestnuts." Peter Martyr[7] describes many varieties, as does also Oviedo[8] and Garcilasso de la Vega,[9] this fact of variety indicating antiquity of culture.

Gray and Trumbull state that it had reached the Pacific islands

[1] One exception may be noted, but I have not opportunity of studying into the authenticity of the statement. In a Spanish MS., 1562, in the island of Palma, by John de Abreu de Gallineo, a Francisan friar, an account is given of the voyage of Betancon to the island of Ferro (Canaries) in 1405. "Their food was the flesh of goats, sheep and hogs; they had also some roots which the Spaniards call batatas." The identity of the roots appears to rest upon the opinion of the writer in 1562, after the introduction of the sweet potato and the American name.

[2] Hist. Rar. Stirp., 1576.

[3] A. Gray, *Am. Jour. of Sc.*, 1883, 247.

[4] Gen. Coll. of Voy. by the Port., Lond., 1789, 433.

[5] Origin of Cult. Plants, 58, note.

[6] Pharmacog., 452.

[7] Third decade Eden's Hist. of Trav., 1577, 143.

[8] Gray and Trumbull, l. c.

[9] Royal Com. Hak. Soc. ed., II, 359.

in prehistoric times, but give no evidence for the statement. I can find nothing which can countenance this belief except in the number of varieties that are cultivated in some islands, as thirty-three in the Hawaiian islands.[1] The name *cumala* in New Zealand, and Otaheite,[2] and Fiji *kumara*[3] is strangely like the *cumar* of the Quito dialect.[4] We may add here that the *camote* of Yucatan was called in the islands *axi* and *batatas*.[5]

Tomato.—Tomatoes were eaten by the Nahua tribes, and were called *tomatl*,[6] and also by the wild tribes of Mexico,[7] and Hernandez[8] has a chapter "*De tomatl, seu planta acinosa* vel *Solano*, and describes several sorts under their Mexican name.[9] It was described by various European botanists of the sixteenth century, which indicates its introduction to Europe, and for this botanical history we may refer to Gray and Trumbull already cited. It seems to have been grown in European gardens as a fruit, from its first introduction, judging from the references in Dodonæus[10] and Gerarde,[11] but Parkinson, 1656, speaks of it as grown in England for ornament and curiosity only. In Italy Chauteauvieux, 1812, mentions their cultivation, on a large scale, for the Naples and Rome market. It is probable that their use was at first more general among southern nations, as we find that the Anglo-Saxon races were the last to receive them into the kitchen garden. Thus in 1774 Long[12] describes the fruit well, and mentions their often use in soups and sauces, and adds that they are likewise fried and served up with eggs. In 1778 Mawe and Abercrombie[13] mention five varieties as known, two of which are described as scentless and burnet-leaved, and add that they are eaten by the Spaniards and Portuguese in particular, and are in high esteem.

In the United States its introduction preceded by many years its use as we at present know it. It is said to have reached Phil-

[1] Wilkes, U. S. Ex. Ex., IV, 282.
[2] Cook's Voy., I, 199.
[3] Seeman, Fl. Vil.
[4] Markham's note in Cieza's Trav., Hak. Soc. ed., 234.
[5] Fourth Voy. of Columbus, Gen. Coll. of Voy. by the Port., 446.
[6] Bancroft, Native Races, II. 356.
[7] ib., I, 624, 653.
[8] Ed. 1651, 295.
[9] Gray and Trumbull, *Am. Jour. of Arts and Sc.*, 1883 p. 128.
[10] Pempt., 1583.
[11] Herbal, 2d ed.
[12] Jam., III, 773.
[13] Gardiner.

adelphia from St. Domingo in 1798, but not to have been sold in the markets until 1829. It was used as an article of food in New Orleans in 1812.[1] The first notice of it in American gardens was apparently by Jefferson,[2] who notes it in Virginian gardens in 1781. It was introduced into Salem, Mass., about 1802, by an Italian, but he found it difficult to persuade people even to taste the fruit.[3] Among American writers on gardening, M'Mahon, 1806, mentions the tomato, but no varieties, as "in much esteem for culinary purposes;" Gardiner and Hepburn, 1818, say: "make excellent pickles;" Fessenden, 1828, quotes from Loudon only; Bridgeman, 1832, says, "much cultivated for its fruits in soups and sauces." They were first grown in Western New York in 1825, the seed from Virginia, and in 1830 were not produced by the vegetable gardeners about Albany,[4] yet directions for cultivating this fruit appeared in Thorburn's Gardeners' Kalendar, 2d edition, New York, 1817. Buist writes that as an esculent plant in 1828–9 the tomato was almost detested, yet in ten years more every variety of pill and panacea was "extract of tomato."[5] Mr. T. S. Gold, secretary of the Connecticut Board of Agriculture, writes me that "we raised our first tomatoes about 1832, only as a curiosity, made no use of them though we had heard that the French ate them. They were called love apples." D. J. Browne,[6] 1854, describes six varieties and says, "the tomato until within the last twenty years was almost wholly unknown in this county as an esculent vegetable." In 1835 they were sold by the dozen in Quincy market, Boston.[7] In the Maine *Farmer*, Oct. 16, 1835, in an editorial on tomatoes, they are said to be cultivated in gardens in Maine, and to be "a useful article of diet, and should be found on every man's table." In a local lecture in one of the Western colleges about this time, a Dr. Bennett refers to the tomato or Jerusalem apple as being found in the markets in great abundance,[8] and in the New York *Farmer* of this period, one person is mentioned as having planted a large quantity for the

[1] *Prairie Farmer*, June 28, 1876.
[2] Notes, Trenton, 1803, 54–5.
[3] Felt's Annals of Salem, II, 631.
[4] Autobiography of Thurlow Weed.
[5] White, Gard. for the South, 312.
[6] Pat. Of. Rep., 1854, 384.
[7] Am. Gard. Mag., 1835, 437.
[8] Me. *Farmer*, Aug. 21, 1835.

purpose of making sauce.[1] In 1844 the tomato was now acquiring that popularity which makes them so indispensable at present, writes R. Manning.[2]

The summing of the above evidence seems to be that the esculent use of the tomato in America does not antedate the present century, and only became general about 1835 to 1840. At the present time sixty named varieties appear in our various seed catalogues, but many of these are synonyms. Of the sixty-four named varieties grown at the New York Agr. Exp. Station in 1883, over fifty may be called sufficiently distinct for garden purposes.

The tomato can escape from cultivation quite readily and become feral. In the fall of 1884 I saw "wild" tomatoes growing upon the rocky sides of a railroad cutting in New Jersey, a few miles from Jersey City, and these resembled the red cherry. Unger[3] refers to their occurrence on the Gallapagos islands. Wilkes[4] mentions several sorts in the Feejee islands, but whether wild seems doubtful from the reference. On Ascension island they are said to have become completely established all over the island,[5] and Grant mentions their occurrence in Central Africa, 7° 21′ S., and near swamps 4° to 5° S., the natives not yet having learned their edible quality.[6]

We have now completed our list of American kitchen garden plants, which includes the *alkekengi,* four species of *bean,* one species of *cucumber, Jerusalem artichoke, martynia,* two *nasturtiums, peppers, potato, pumpkin* and *squash, purslane, tomato, sweet corn* and *sweet potato.* From the list of kitchen esculents recognized by Vilmorin,[7] we can add the *pine apple, quinoa, Apios tuberosa, aracacha, pea nut, ysano, claytonia, spilanthes, œnotheria, strawberry* two species, *hop* and *oca* in two species. Of these the pineapple and strawberry are rather to be regarded as fruits, the Apios seems rather to be included as a desirable plant for trial than as actually cultivated, and the hop is a native of both worlds.

[1] Me. *Farmer,* Sept., II, 1835.
[2] Hist. Mass Hort. Soc., 269.
[3] Pat. Of. Rept., 1859, 357.
[4] U. S. Exp. Exp., III, 35.
[5] Gard. Chron., 1855, 851.
[6] Speke's Nile, 576.
[7] Les Pl. Potageres, 1883.

MOURNING AND WAR CUSTOMS OF THE KANSAS.

BY THE REV. J. OWEN DORSEY.

NOW, as the Kansas are few, all the men of the tribe assemble and go on the war path; but formerly it was not so. Then a sufficient number of warriors could be raised from a few gentes, probably among the gentes connected with the deceased by blood or marriage. Then a pipe was given to one who was an important man in the tribe; and he fasted for six days before summoning the warriors to join him in the expedition.

An account of the ceremonies observed at the death of Hosasage, a Kansas, in the winter of 1882–3, will show the present customs of the tribe. The authorities from whom the information was obtained were the war captain of the tribe, Paha^{n}le-gaqli; Waqube-k'i^{n}, the chief of the Eagle gens, and Nixüdje-yiñge, the principal sacred man or doctor of the tribe.

As soon as Hosasage died, his father-in-law, Wakanda, went after Paha^{n}le-gaqli, the war captain. The old man said, "Hosasage is dead. Therefore I have come to tell you to take the sacred pipe." The reply was, "Yes, I will take the sacred pipe. I will also take the sacred bag." Wakanda returned home, reaching it as day was coming. Paha^{n}le-gaqli took the mysterious objects, and put clay on his face as a sign of mourning. He fasted, performing the ceremonies of the ancients. At day he took the pipe and went to the house of the deceased. Hosasage's affinities had laid out the corpse, placing the body in the house near the door, and with the head to the east.

A skin tent was erected outside, extending from the front of the house towards the east. Representative men from all the gentes entered the tent and took their stations, as in the accompanying figure, beginning with No. 1.

When Paha^{n}le-gaqli arrived he first stood at *C*. Then the body was brought from the house and placed at *B*, with the head to the east. Then Paha^{n}le-gaqli stood at *D*, where he wept a great deal for the dead. He could not touch the corpse or any other dead body.

After mourning for him a long time, he said, "I will sit still for four days, smoking the sacred pipe. Then will I wander about, and I will kill any animals that I find." Then he condoled with all present. After which Wakanda took the ghost *(sic)* from the corpse, and carried it back to the house, crying as he went. Then

Paha^{n}le-gaqli selected four young men to act as servants for himself and the warriors.[1] They were Gahia-ma^{n}yi^{n}, of the Turtle gens; Iȷuka-gaqli, the brother Paha^{n}le-gaqli, of the Black eagle gens; Tcehawale, or Shield, of the same gens; and Tadje-k'uwe, of the Qüya or Eagle gens. This last is the brother-in-law of Paha^{n}le-gaqli. All are Yata men, *i. e.*, men from gentes on the left side of the tribal circle. They were called djexe-k'i^{n}, or *kettle-carriers*, answering to the Osage ȷsexe-k'i^{n}. Next Paha^{n}le-gaqli desired four men to act as duda^{n}wayüla^{n}, *leaders of the expedition*, or qlets'age. They always decide what is to be done, as the duda^{n}hañga, or war captain, cannot do that. On this occasion the men chosen were Kibaqla-hü, of the Elk gens; Jiñga-wasa, of the Qüya (Eagle) gens; Cu^{n}mikase (Wolf), of the Ibatc'e

A. The corpse in the house.
2. An Upa^{n} (Elk) man.
4. A Qüya (Eagle) man.
6. A Ha^{n} (Night) man.
8. An Ibatce (Chicken hawk and Raccoon) man.
10. A Hañga-tañga (Black eagle) man.
12. A Tceduñga (Buffalo bull) man.
14. A Tciju Wactage (Peacemaker) man.

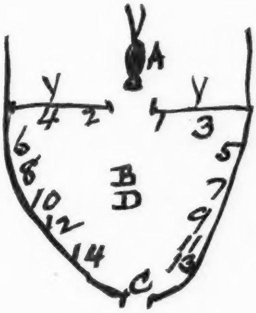


Fig. 1.

Y. The front of the house.
1. A Ma^{n}yiñka-gaxe man.
3. A Ta (Deer) man.
5. A Ka^{n}ze (Kansas, wind) man.
7. A Pañka (Red cedar) man.
9. A Wasabe (Black bear) man.
11. A Lu (Thunder) man.
13. A Ke (Turtle) man.

gens; and Wats'aji, of the Black bear gens. Three were Yata men, and the fourth was an Ictuñga (Right) man.

The directors consulted one another, saying, "Let us go on the war path in four days." Then they addressed Paha^{n}le-gaqli for the first time in their official capacity, "O war captain, let us go on the war path in four days." Then Paha^{n}le-gaqli announced their decision to all the others present, saying, "O comrades! in four days I will go on the war path."

As a reward for his services Wakanda gave Paha^{n}le-gaqli a spotted horse, two red blankets, two white ones and a calico shirt. The two red blankets, one white one and the shirt were divided at once among the four directors. Then all present, ex-

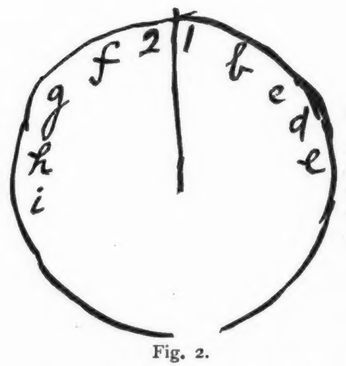
[1] Nixüdje-yiñge says that there are six instead of four when the waqpele gaxe is performed.

cept Paha^{n}le-gaqli, returned to their homes. Paha^{n}le-gaqli could not go to his home for four days. He had told the kettle-carriers to make him a small lodge by the course of a small stream which used to flow near his house. This was done by Gahia-ma^{n}yi^{n} and Tcehawale. Paha^{n}le-gaqli was required to fast, wandering about and crying in solitary places, having clay on his face. At sunset his brother, Iʇuka-gaqli, brought him water. Then could the mourner wash his face and drink a cupful of the water, but he could eat no food. After sleeping awhile at night, he arose and put more clay on his face. At sunset on the fourth day the four directors went to the house of Paha^{n}le-gaqli and sent the four kettle-carriers to summon the mourner to his house. Then was he permitted to take food. The next morning he went for Gahia-ma^{n}yi^{n} and Tcehrwale. Before they arrived he and his wife left their house. He ordered them to invite the guests to his lodge. The messengers went in different directions, saying to each invited guest, "I have come to call you to go on the war path." And each man replied, "Yes, I will go with you." A lodge was set up near the house of Paha^{n}le-gaqli, and there the guests assembled.

Only two gentes met as such, the two Hăñga gentes, Black eagle and Chicken-hawk, but there were present the directors and kettle-carriers, some of whom were members of other gentes.

The following figure shows the seats of the Hăñga men in the lodge:

Chicken-hawk men.
2. Ali^{n}kawahu.
f. Cu^{n}mikase.
g. Wat'i^{n} li^{n}.
h. Mik'a-ha.
i. Ile-ha.



Black eagle men.
1. Paha^{n}le-gaqli.
b. Iʇuka-gaqli.
c. Nixüdje-yiñge.
d. Nu^{n}pewaye.
e. Qüyulañge.

Fig. 2.

Paha^{n}le-gaqli, who took his seat suddenly when the guests arrived, was present in two capacities, as war captain and as the

head of his gens; Cuⁿmikase was there as a member of his gens and as a director; and Iʇuka-gaqle was there as a member of his gens and also as a kettle-carrier,

Only three were allowed to sing the sacred songs, Aliⁿkawahu, Gahiⁿge-wadayiñga (who died in Jan., 1883) and Pahaⁿle-gaqli.

Two young men, one of the Turtle gens and one of the Qüya (Eagle) gens, attended to the sacred boiling (for the feast). Pahaⁿle-gaqli sent Tadje-k'uwe for the sacred clam shell, saying,

Fig. 3.

"I will take the large covering and the large bowl too. I will perform a sacred ceremony. Go for them." These objects were at the house of Pahaⁿle-gaqli, beyond the person addressed. The clam shell had been brought from the "great water at the east" by the ancestors of the Kansas. This was the case with all the sacred objects of the tribe, including the pipes and sundry roots used as medicines. The shell was opened and made like the face of a man, with eyes, teeth, etc. The above sketch was made by Pahaⁿle-gaqli.

When the sacred pipe is smoked by a Large Hăñga (Black eagle) or a Small Hăñga (Chicken-hawk) man, he must hold it in his right hand, blowing the smoke into the clam shell, which is held in his left. The smoke is supposed to ascend to the thunder-god, the god of war, to whom it is pleasant. There are five envelopes or wrappings for the shell, similar to those around the war pipe. All of the wrappings are called the "i^{n}he-cabe." The inmost one is the bladder of a buffalo bull; the next is the spotted fur of a fawn; the third is matting made of the tall grass called sa; the fourth a broad piece of deer skin; the outmost one is interwoven hair from the head of a buffalo bull.

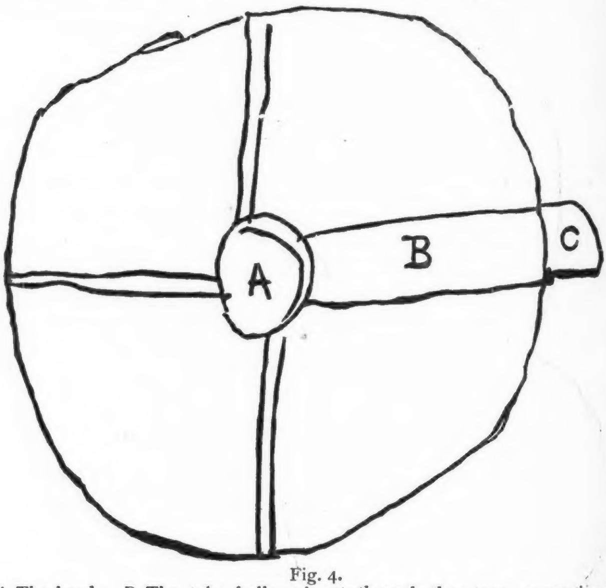


Fig. 4.

A. The bowl. *B*. The tube hollowed out through the stone, connecting the mouth-piece (*C*) with the bowl.

The war pipe was kept by Paha^{n}le-wak'ü (son of Ali^{n}kawahu), who died in 1883. It is made of red pipestone (i^{n}yi^{n}), and is called i^{n}-jüdge nanüŭ^{n}ba or nanüŭ^{n}ba jüdje. The stem forms part of the stone, being just long enough to be put between the lips. The stone is about the thickness of two hands (two or three inches). On each side of the pipe is an eye, that it may see the enemies. The opening of the bundle containing it is regulated by Ali^{n}kawahu. A figure of it is appended, showing its appearance on top.

The bundle containing the clam shell was brought by the young man who went for it, and placed before Pahaⁿle-gaqli. Aliⁿkawahu took the bundle and began the sacred song. Pahaⁿle-gaqli soon joined him in the singing.

The accompanying chart used by these singers is a *fac-simile* of one drawn by Pahaⁿle-gaqli, who copied it from one he inherited from his father and father's father. There used to be many other pictographs on it. The Osages have a similar chart, on which there are fully a hundred pictographs. Pahaⁿle-gaqli said that there should be a representation of fire in the middle of his chart, but he was afraid to make it. The songs are very sacred, never being sung on ordinary occasions, or in a profane manner, lest the offender should be killed by the thunder-god.

Fig. 1 the sacred pipe, Waqube wakandagi. Three songs refer to it. They are sung when Aliⁿkawahu removes the coverings. One is as follows:

"Ha-ha′! tce′-ga-nu′ ha-ha′!
Ha-ha′! tce′-ga-nu′ ha-ha′!
Ha-ha′! tce′-ga-nu′ ha-ha′!
Hü-hü′! (Said when the envelopes are pressed down on.)
Chorus—Yu! yu! yu! Hü-hü′! Hü-hü′! (Sung by all the Black eagle and Chicken-hawk men.)

This chorus is an invocation of the thunder-god. In making it the arms are held up to the sky, being apart and parallel, with the palms out. Each arm is rubbed from the wrist to the shoulder by the other hand.[1] After the singing of these songs, Pahaⁿle-gaqli receives the clam shell and puts it on his back.

Fig. 2, Ts'age-jiñga wayüⁿ, (Two) songs of the venerable man or Wakanda, the maker of all the songs. When Aliⁿkawahu and Pahaⁿle-gaqli are singing these two songs, they suppose that he walks behind them, holding up his hands to the thunder-god in prayer for them. On the special occasion referred to in this paper, the expedition after the death of Hosasage, when these songs had been sung, Pahaⁿle-gaqli shifted the shell from his own back to that of Jiñga-wasa, one of the directors. He then ordered another man, Tayé, to put the Iⁿhe-cabe on his back.

[1] This song and invocation is used by the Ponkas.

Fig. 3, song of another old man, who holds a cane. It is this Wakanda who gives success to the hunters. He is thus addressed: "Ts'áge-jiñga haú! Dáble maⁿ'yiⁿ-aú'! Dádaⁿ wadjü'ta níkaci'ga ckédaⁿ wáyakípa-bádaⁿ, ts'éya-bánahaú!— *O venerable man! Go hunting! Kill whatever persons or animals you may meet!*" They think that this being drives the game towards the hunters.

Fig. 4, Tadje wayuⁿ, wind songs. The winds are deities; they are Bázaⁿta (*at the pines*), *the east wind;* A'k'a, *the south wind;* A'k'a jiñ'ga or A'k'uye, *the west wind;* and Hníta (*towards the cold*) *the north wind.* The warriors used to remove the hearts of slain foes, putting them in the fire as a sacrifice to the winds.

Fig. 5, songs of the large star (Venus), which is a Wakanda or god.

Fig. 6, Jaⁿ-miⁿdje wayuⁿ, bow songs. This is the bow of a Wakanda, probably that of the old man who aids the hunters.

Fig. 7, song of sacrifice to the deities. The sign for this song is a hand of which four fingers are seen. As this is sung some gift is thrown down and left as an offering to the Wakanda, and to all the deities, those above, those under the hills, the winds, Venus, etc.

As Aliⁿkawahu and Pahaⁿle-gaqli are Yata people, they elevate the left hands, beginning at the left with the east wind, then turning to the south wind, next to the west wind and lastly to the north wind. To each they say, "That I give to you, O Wakanda!" They used to pierce themselves with knives or small splinters, and offer small pieces of their flesh to the deities.

Fig. 8, deer songs. Fig. 9, an elk song. Fig. 10, seven songs of the old man or deity who makes night (songs).

Fig. 11, five songs of the big rock. This is a rough, red rock near Topeka, Kan. It has a hard body, like that of Wakanda. "May you continue like it!" is the prayer of the singers.

Fig. 12, four wolf songs. The wolf howls at night.

Fig. 13, five moon songs. The moon shines at night.

Fig. 14, four crow songs. The crow flies around a dead body that it wishes to eat.

Fig. 15, Two songs of the yarn belt. This kind of belt was worn by the old men over their buffalo robes.

Fig. 16, song of an old man or deity. Fig. 17, three noon songs. Fig. 18, two shade songs. The shade is made by a

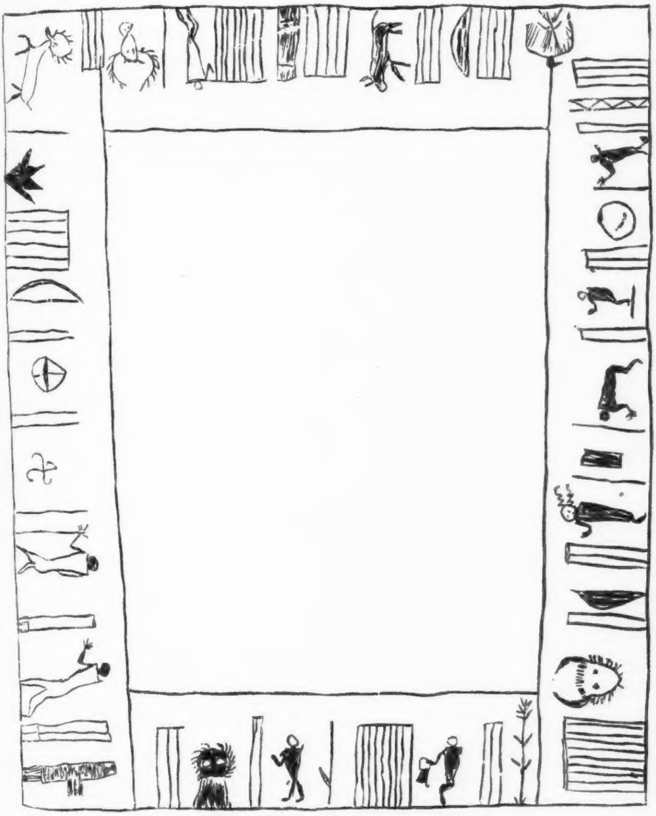


Chart used by the Kansas.

deity. Fig. 19, a dream song. There is a deity who makes people sleepy. Fig. 20, song of the small rock.

Fig. 21, three songs of a tribe of Indians who who resembled the Witchitâs. The Kansas used to fight them. The two locks of plaited hair are not symbolic. Their faces are marked thus:

Fig. 22, two songs of the new moon. Fig. 23, ten songs of the buffalo bull. Fig. 24, planting songs. Fig. 25, cooking songs. The old man takes water in the kettle for boiling the corn and for drinking. Fig. 26, songs about walking with stilts. The Kansas used to walk on stilts when they forded shallow streams. Fig. 27, three owl songs. The owl hoots at night.

All the men had picketed their horses outside the lodge before the singing of the songs, and they had brought in their saddles.

After the singing Pahaⁿle-gaqli lighted and smoked the war pipe, and then handed it to all the others. After smoking they slept there. When the sky was getting light, before sunrise, the men took clay which they rubbed over their faces. All rose to their feet within the lodge and cried. They ceased crying when the sky became white. They went out, put the saddles on the horses, mounted them and departed. Pahaⁿle-gaqli kept far behind the others. All cried. By and by they reached the other side of the Arkansas river; then they reined in their horses and dismounted. Pahaⁿle-gaqli took the clam shell and gave it to one of the four directors to carry on his back. Subsequently they killed five prairie chickens. Thus was life taken, and the mourners were satisfied. They went on till they reached a small stream, beside which they encamped. A fire was kindled and the two kettle-carriers who had made the small lodge at the first, went for water; they gave water to all the warriors, who washed off the clay from their faces. They ate the prairie chickens and then started homeward. All returned to the house of Pahaⁿle-gaqli, where his wife put a kettle on the fire and gave them a meal. All partook of it and then separated, going to their respective homes.

According to Nixüdje-yiñge, two qlets'age were chosen for each side of the tribe. They carried on their backs thread or sinew for mending their moccasins, and corn and squashes in

bags. The war captain had a tobacco pouch of skunk skin. When he smoked he was ever praying, "O Wakanda! I wish a Pani Loup to die!"

The war captain made one of the qlets'age carry the sacred bag before the ceremony of "wáqpele gáxe" was performed. On this occasion there were six kettle-carriers instead of four. When the qlet s'age carried the sacred bag two of the kettle-carriers carried a bundle of sticks apiece, which they laid down on the road, one end of each bundle pointing towards the land of the enemy. Four of the kettle carriers remained still. The next morning all the warriors went to the spot; they drew a circle around the bundles and set up one stick within, which they attacked as if it were a Pani. This might cause, in their opinion, the death of real foes. Members of the Lu, or Thunder gens, could not take part in this ceremony, but were obliged to keep in the rear. The following prayers were said during the wapqele gaxe, according to Nixüdje-yiñge: "I wish to pass along the road to the foe! O Wakanda! I promise you a blanket if I succeed!" This was said facing the east. Turning to the west the following prayer was made: "O Wakanda! I promise you a feast if I succeed!"

On the return from war, during the scalp dance which followed, the wife of the war captain held the scalp and the war pipe as she danced.

U'ce-gu^{n}ya, an aged man of the Black bear gens, told the following: In former days when a man lost a child he cried for it, and became a war captain. Two persons built him a small lodge and filled a small kettle with corn. When the corn was boiled, which was about dark, the captain gave a little of it away, but he ate none. He fasted because he wished to kill an Indian. The warriors departed the next day. The kettle-carriers took corn, meat, moccasins, small kettles and spoons. During the "waqpele gaxe" the following petitions were made. "I wish to kill a Pani! I wish to bring back horses! I wish to pull down a foe! I promise you a calico shirt! I promise you a robe! I will also give you a blanket, O Wakanda, if you let me come home after killing a Pani!"

War Dances.—There are two dances before going to war, the Maka$^{n\prime}$ watci$^{n\prime}$ and the Wacábe watci$^{n\prime}$. The former may be danced at any season. It is designed to increase the warlike spirit

of the men. The following diagram shows the position of the different actors:

The fire or fireplace is in the middle of the lodge.
c. Four women on each side.
d. The men.

A. The principal keeper of the maka^{n} or medicine.
B. His two assistants.
e e. Two servants or messengers.

Fig. 5.

The Wacabe watci^{n} is danced four days before going on the war path, in warm weather. There are about forty followers besides the leaders. They divide into two parties of equal numbers and dance out of doors, around the village, half going in one direction and half in the other. Each of the four qlets'age carries a standard or waqléqle skă, made of swan skin (mi^{n}xa-ha). Two of these men are in each party. The he wáqleqle or wacábe, from which the dance takes its name, is borne by the wadjípa^{n}yi^{n} or village crier, a member of the Deer gens. When they start on the war path the qlet s'age go horseback, carrying their standards.

The two dances after returning from war are the Watce watci^{n} or scalp dance, danced by the women, and the Ilucka wat ci^{n}, danced by the men alone.

Other Burial and Mourning Customs.—When Wm. Johnson, a Kansas, died, he was buried by his wife, his sister and his sister's daughter. As the widow did not wish any of the tribe to go on the war path, she did not send for Paha^{n}le-gaqli. So neither he nor the other men assembled at the house of the deceased, as in the case of Hosasage.

When a man's wife dies, the husband must put earth on his face at daybreak, and wander about till sunset, bewailing his loss. He must fast from sunrise to sunset for a year and a half. After sunset he washes his face. and can eat and sleep. At the end of the period of mourning, the widower says to his wife's brothers, "I will give you a horse, a red blanket, a white blanket, a calico

shirt and a kettle." One of them replies, "Yes, my sister's husband, that is good." The presents are made the next morning at daybreak. The elder brother-in-law takes the horse, and the next receives the other gifts. At noon the widower washes his face and seeks another wife.

In like manner when a woman loses her husband she must put earth on her face and fast during the day from sunrise to sunset for a year. She too can eat after sunset. At the end of the year she brings the gifts to the sister and younger brother of her husband. The sister gets the horse and the brother takes the rest.

When a widower does not make presents to the kinsmen of his deceased wife before marrying again, he is sure to provoke the anger of his brothers-in-law. Formerly an old man took a gun and shot at his sister's husband for this reason. And another man, when the Kansas were south of Council Grove, Kan., took a knife and gashed the head of the offending man in several places. Therefore widowers are accustomed to observe this rule of making presents, fearing the punishment which their offended affinities might inflict on them.

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THE RELATIONS OF MIND ,AND MATTER.

BY CHARLES MORRIS.

(Continued from p. 542, June number.)

II. The Nervous Mechanism.

IN all the higher animals a system of fibers and cell masses forms the channel by which external energy enters the body, and is distributed to its every organ and tissue. There is considerable variation of form and condition in this apparatus, but it is essentially a single organic agent, and includes the muscles as part of its organism. There is little apparent differentiation in the fibers. The main differentiation is in the endings of these fibers. Of these endings a very great number exist on the surface of the body, where they are variously modified and adapted to different purposes. These are the receiving organs, through whose aid external energy reaches the conducting fibers. They are varied to receive every form of external energy. This energy beats upon the surface of the body in at least six forms or modes. One of these is that known as ethereal vibration, through which far distant objects make themselves felt. Part of these vibrations

enter the body through a specially organized nerve apparatus, the rods and cones of the eye. But they all, as radiant heat, enter at every part of the surface, by aid of less specialized nerve endings. Heat in another condition, the static vibrations of contiguous matter, also enters at every part of the surface, presumably through the same channel. A second series of vibrations, those of ponderable matter, enter by the channel of the ear, through the aid of an intricately organized apparatus. In addition to these three conditions of vibratory influence there are three modes of direct contact through which motor energy also makes its way into the body. These are solid, liquid and gaseous contact. Gaseous contact enters by a special channel, that of the nerves of smell, which are excited by the touch of excessively fine material borne on the air current. Liquid contact finds its special channel in the nerves of taste, which are only sensitive to the direct touch of liquified or dissolved matter. Solid contact has the whole surface for its field. The nerves of touch, indeed, are also sensitive to liquid and gaseous contact if exerted by matter in motion, but mainly respond to the contact and pressure of solid matter.

The internal extremities of the nerves lack the variety of their surface endings. They are distributing organs as the latter are receiving organs. The energy received varies greatly in character, and needs considerably varied apparatus for its reception. That distributed has become far more homogeneous and can be dispersed by a single apparatus. This is the muscle fiber, which, though not ordinarily considered so, is essentially but a nerve ending, an aggregation of unstable chemical molecules around the extremity of a nerve. And the combined aggregates of these fibers, which constitute a muscle, are but a mass of nerve extremities ending in matter which is adapted to set free a considerable volume of motor energy.[1] Into this matter the energy which has traversed the nerves is discharged, and there instigates an active chemical change and a rapid freeing of energy, with animal motion as its result.

Such is reflex action, a frequent mode of nerve action in man, and possibly the only one in many of the lower animals. Motor energy differing greatly in character and source is thus forced to produce a single effect, that of muscular contraction and animal

[1] See Organic Physics, AMER. NAT., Feb., 1883.

mass motion. But in all the higher animals other effects are produced. All the nerve fibers enter cells or masses of cells called ganglia, though there is no evidence that they end there. There is some reason to believe that they simply pass through these cells, with a reduction of diameter, and perhaps a division into branches. All we can be sure of is that the motor energy which they carry inward does not all pass through these ganglia, but that much of it is arrested in its course and there distributed. And in this distribution an interesting feature of the case is, at least so far as the cerebral ganglion is concerned, that the motor energy retains the peculiarities it possessed before entering the body, or something equivalent to them, and impresses a permanent record of each such peculiarity upon some internal tablet. Only when this energy continues its course over the nerves to the muscles does it lose its individuality and merge in the general outflow of muscle energy.

As we descend in the animal kingdom it is to find this complex apparatus of sensation and motion gradually simplify. The sensory nerve-endings and their organs grow less intricate, and their susceptibility is diminished. Some of the organs of special sense completely disappear, and the power of the others becomes little more than a modified touch. In very many cases the body is covered by a rigid armor, and the influence of external energy is limited to a small region of the surface. Finally the special senses disappear, apparently the last to vanish being that of sight, which is reduced to a vague discrimination between light and shade. The cerebral ganglion grows less and less marked, and disappears as a special organ. Finally the nerve and muscle fibers vanish, one of their last traces being the single cell which, in the Hydra, appears to function both as nerve and muscle. On reaching the Protozoa we find forms quite destitute of sensory and motor organs. And yet sensation and motion persist. These powers seem to be native to protoplasmic matter, however aggregated, and are displayed even in the plant cell wherever it is so situated that its protoplasm is exposed to external energy.

Yet late discoveries in regard to the constitution of the cell prove it to be by no means the simple homogeneous structure formerly supposed. The division into nucleus and outer cell has been traced to a very low level, and perhaps exists at the lowest level. And the nucleus, and to a less marked extent the outer

cell, are now known to be heterogeneous in structure, composed of at least two distinct substances, one of which exists as very minute fibrils, of which the other occupies the interspaces. This organization, very well marked in the cells of the higher animals, becomes much less so in the Protozoa, and is only clearly distinguishable in their higher representatives. Yet this is probably due to the imperfection of instruments and methods. The nervous structure has been only recently discovered in the Medusæ, and has not yet been traced in the stem of the compound Cœlenterates, though this conveys sensory impulses, and doubtless contains communicating fibrillæ. In like manner the fibrillar structure may exist in all cells, though not always sufficiently defined to be discoverable.

Again the cilia, so common in the single-celled life forms and in many of the surface cells of higher animals, have been traced in some instances into direct connection with the fibrillæ. Perhaps in all cases they are external continuations of the fibrillæ, and may thus function as the primitive nerve-ending, the sensory termination which receives impressions of external motor energy and transmits it to the fibrillæ to be distributed throughout the substance of the cell. There is thus some reason to believe that the developed motor apparatus of the highest animal has its primitive counterpart in every cell, and that the unfolded nervous and muscular organism of man is but a direct development of that existing in the Infusoria. In Amœba the pseudopod may function as a sensory organ and receive motor impressions which are distributed throughout the cell mass. Tissue contraction seems to be the general result of such motor influence, however received and distributed.

Late research indicates the method of development of this primary motor apparatus. It has been clearly shown that fine threads of protoplasm connect contiguous cells in frequent instances. Observers have seen this structure in the cells of numerous species of plants, and some writers look upon it as universal in plant cells. In addition to the protoplasmic threads which join the nucleus to the cell wall, others pass through the wall, probably through minute apertures, and connect with the protoplasm of one or more neighboring cells. Possibly this may be a result of cell division. When one cell separates into two its protoplasm may not completely separate. And it is quite conceivable that

this net work of protoplasm, which connects all the cells of many and possibly the active cells of all plants, may have a nervous function, though the conditions of plant life are such as seldom to call it into exercise.

In animals a similar structure has been observed in many cases, and particularly between epithelial cells, where it is most likely to be called into functional activity. Some observers claim that it is general, and that the animal body is an intricate net work of fibrillæ, of which the cells forms the nodes. This doctrine, though it has been strongly combatted, is certainly not without considerable support in observation, and there is good reason to believe that such continuity of protoplasm exists between the cells of at least several of the animal tissues.

Thus the primitive motor organism quite probably exists with little change throughout the highest animals, and may serve to bring every cell within the reach of motor influences, as the similarly minute vascular structure has a like result in regard to nutritive influences. The conditions here indicated, however, exist in very different degrees of perfection in different cells. In some tissues they may almost or quite have ceased to exist through lack of exercise. In nerve tissue, on the contrary, they are remarkably well developed. The large nerve cells of the ganglia possess an intricate fibrillar structure, so distinctly developed that it was clearly recognized long before any one imagined that such a structure was a common feature of cells. And the extrusion of protoplasmic threads through the cell walls, in direct continuation of the internal fibrils, is equally well marked. The whole surface of some of the cells is covered with a series of fine nerve rootlets. Yet greatly developed as this structure is, there is no reason to doubt that it is a direct unfoldment of the general cell structure, with its nuclear and outer cell fibrils and its one or more protoplasmic threads running to neighboring cells. In the case of nerve tissue the rootlets also connect with other cells, but the connected cells are often separated by very considerable intervals. Very likely this separation is a result of natural selection. In original Metazoa sensory impressions may have passed from cell to cell through the aid of their connecting protoplasmic threads. In forms in which no nerves can be discovered this method may still continue, as a slow yet sufficient process. But as animal life developed the connected cells seem to have become

more and more widely separated, the fibril growing thicker and becoming a nerve fiber, with the power of conveying motor energy more rapidly and in greater quantity. Through some such process successive steps of evolution may have led to the condition now existing in the highest animals, with very numerous fibrils emanating from the cells, their combination into bundles with an insulating covering, and their final distribution to distant cells.

For this idea we have a degree of embryological warrant, and can trace the nerve organism to one of its ancestral stages. For, as observed by Beale, the cells from which the nervous system arises form processes which connect adjacent cells together. They are thus direct counterparts of many, and perhaps of all, tissue cells. As growth goes on these cells separate, while their connecting processes lengthen and form the axis cylinder of the nerve fiber. In this we seem to perceive the phylogenetic development of nerve tissue. Eventually, as some observers consider, one of these cells becomes a cell in a nerve ganglion, the other a peripheral end organ, their connecting process being lengthened out into a nerve fiber. That in this we have an exact representation of the mode of development of nerve tissue, however, is far from certain. If so we should find each nerve fiber proceeding directly from one to the other extremity without intermediate ganglia. The frequent existence of these ganglia leads to another conclusion, and indicates that the original development pursued another line, which has been slurred over in the rapidity of unfoldment like so many embryological characteristics. Various hypotheses of the mode of development of nerve tissue have been heretofore offered, the most notable being that of Herbert Spencer, but these are mainly philosophical. Still another may be offered which is in direct consonance with the recent discoveries in cell and tissue formation above described, and which future embryological research may fully substantiate.

The hypothesis which we propose is the following. We have seen some reason to believe that in single-celled animals the motor impressions received by the cilia or otherwise are distributed throughout the cell by the fibrillæ. This distribution is at first general, but in case of special motions may become special, certain fibrillæ becoming specially capacitated, through exercise in this function, to convey the current. In Metazoan animals

the connecting threads of protoplasm between the cells are doubtless competent to convey motor impulses from cell to cell, and they very probably preceded the development of nerves as a sensory arrangement, permitting a slow and general transmission of motor influences to every part of the body. But if any particular motions became habitual, through natural selection, the sensory inflow must have become to some extent specialized, following certain channels of conduction more frequently than others. But nutrition always attends activity, and in these special lines the fibrils must have grown larger and more capable. If their labor still increased, a second change must have succeeded. The line of special conduction being mainly composed of cells, with short interconnecting fibrils, a modification necessarily took place in the cells also. If the outer threads had continuous fibrillar connection through the cells, which we have some warrant to assume, these cell fibrillæ must have grown larger and straighter as a result of extra nutrition and natural selection. They may, indeed, have exhausted the cell nutriment and caused the abortion of the remaining filaments. In short, a continuation of this process of evolution may have caused the gradual disappearance of most of the cells in the line of conduction, and the conversion of their fibrillæ into direct continuations of the developing nerve fiber.

The make-up of the axis cylinder of every nerve fiber is in strong corroboration of this idea. It is found to consist of numerous extremely delicate fibrillæ imbedded in a finely granulated substance. Nuclei are also found in it. Thus it is closely analogous to the cell in composition, and presents strong indications of originating in a connected line of cells. Another feature of the nerve fiber is an interesting confirmation of this. The medullary sheath seems but a special elongation of the outer layer of the cells. It does not exist in the primitive nerve, of which we have probably a survival in the nerves of the sympathetic system. It seems the result of a fuller development, yet the fatty and albuminous matters of which it consists are the substances which exists most abundantly in the outer cell layer. Conversion into fatty matter is a general characteristic of deteriorating cells. Thus every portion of the nerve fiber can be traced directly to the cell, with singularly little change, and there is certainly much reason to believe that nerve conduction is an outgrowth of a

primitive connected-cell conduction. All these cells did not disappear or suffer conversion. Some were retained, perhaps as centers of distribution, by whose aid a single inflowing current could be sent off in several directions as a partial survival of the original general distribution. And significantly, near these cells the axis cylinder is naked. The cell matter has not been converted into a medullary sheath. Yet more significant indications of such an origin of the nerve system are seen in the *bipolar* nerve cells. In these a nerve fiber enters the cell on each side, and its fibrillated structure is clearly continuous with the fibrillæ of the cell. And in many cases the medulla of the fibers is continued over the cell. Such a cell, therefore, appears to be a survival of the primitive nerve, and indicates its origin, as above conjectured, from a line of cells with protoplasmic fibrillar connections.

There is one more point here to consider, that of the termini of the nerve fibers. It is quite probable that they never terminate in the ganglionic cells, not even in those of the cerebrum, but that they connect with the fibrillæ of these cells, which in their turn connect with outgoing fibers. Nor is it by any means sure that they have actual termini in the peripheral and muscular cells. Indications point to the contrary. In many cases they seem to pass continuously through these cells and rejoin the exterior nerve fibrils, or to end in a plexus whose fibrillæ are probably continuous. Thus in the highest development of nervous tissue there is singularly little change in structure from the condition of undifferentiated cell tissue.

We may look upon the function of the nerve fibers as simply conductive, though it is possible that they add to the strength of the motor current through chemical change which takes place in their tissue. What is the function of the nerve cells? Very probably their action resembles that of the electric resistance coil. In telegraphy by decreasing the diameter of the wire the passage of the current is resisted, and part of it loses its electric character. By suitable contrivances this checked current may be converted into heat, light, magnetism or other forms of force. In the nerve cells the minute fibrillæ over which the current must pass seem to have a similar function. Part of the motor energy is converted into some other form of force. It may become heat. It may outflow into the high-atomed muscle molecules and cause chemical change. Or it may assume some other condition, as it

very evidently does in the cerebral cells. There are possibly no actual nerve termini anywhere within the body, but simply occasional resistance nodes, in some of which a single inflowing current may be divided between several outgoing channels, but in many or all of which the current is checked and partly converted into some other mode of motion.

It is not necessary here to go into any minute description of the nervous system. In man it is virtually double. In addition to the external sensory and motor system, there is a secondary system which is devoted to the needs of the digestive cavity and to other internal duties. These systems are similar in general make-up, consisting of ganglia and communicating fibers, which extend partly to muscles and partly to the epithelial layer. But they have marked differences. The sympathetic has no central ganglion answering to the cerebrum. Its operations are all performed without consciousness except through the occasional aid of its cerebral nerve connections. And in its nerve fibers the axis cylinder is destitute of a medullary sheath. Some writers consider that its operations may have been originally conscious and have become unconscious and simply reflex through incessant repetition. Yet this is very doubtful. It presents every appearance of being a survival of a primitive nerve condition, beyond which it has not greatly developed. Consciousness is a condition that must have been originally vague and generalized, and which but slowly grew specialized with the gradual centralization of the nervous system. We cannot imagine it as retrograding and disappearing in any developing nervous system. In fact, the system of intestinal nerves has never become centralized and definite. Such consciousness as it may possess retains its original vagueness. Its functional existence is perhaps as ancient as that of the external nerve system, but its development has been much slower. When the latter had advanced to the condition of distinct nerves and ganglia, the former yet remained in the primitive stage of cell conduction. The nerves of external sensation have gained an insulating sheath while those of intestinal sensation remain naked. The one has become definitely centralized while the other yet lacks special organization. These results flow from their difference of duties, which in the one case are simple and unvarying, in the other complex and excessively varied. As a result such consciousness as may exist in the intestinal system

retains the dim vagueness which probably exists in animals of a very low grade. But in the cerebro-spinal system consciousness has become sharply centralized and defined. The peculiar condition which we call consciousness may have its roots very low down in the soil of nature as a highly generalized accompaniment of motor energy. In the evolution of higher forms and conditions it has grown steadily more specialized, until, in the central nerve organ of man, it has become a concentrated, developed and sharply defined condition, the necessary accompaniment of an equally special centralization of substance and energy, which we name the mind.

The cerebro-spinal nerve system in man and the higher animals has become a highly differentiated and complex organism, whose make-up may be very briefly described. The sensory nerves, which convey motor impressions from the various points of the surface, pass through a series of spinal ganglia in their upward journey toward the brain. Here they enter the great ganglia at the base of the brain, to which the nerves of some of the special senses pass directly. From here they communicate with the cerebrum, though whether directly or indirectly is not certain. It is certain that when the cerebrum is removed many of the sensory nerves are found to be in direct communication with those of motion. It is almost equally certain that in ordinary cases many sensory impressions are directly passed on to the motor nerves, with or without consciousness. These intermediate ganglia, then, may perform a special duty in the economy which we will consider further on. From the cerebrum motor nerves enter these ganglia, from which the same or other motor nerves emerge and pass onward, mainly by the route of the spinal ganglia, to the muscles.

According to M. Luys[1] the cerebral organ is composed of a vast array of fibers which diverge to enter a hemispherical sheet of gray or cellular nerve matter. This gray sheet is greatly wrinkled and folded so as considerably to increase its superficial extent. It is of no great thickness, and is composed of successive layers of nerve cells connected by fibers, these cells being smaller in the surface layers and growing larger in the deeper layers. The hemisphere is really a double mass, since it is divided in the middle line of the body, the two halves being con-

[1] The Brain and its Functions, International Scientific Series.

nected by a thick commissure of nerve fibers. The cerebral cells are pyramidal in shape, the summit of the pyramid being directed upwards. Each of these cells gives off a delicate fringe of fibrils like the fine rootlets of a plant, which spread out in an interlaced network and form a continuous fine plexus. These fibrils are believed to be the origin of the sensory nerves, becoming aggregated and covered with a medullary sheath. In addition to the processes which thus break up into rootlets of protoplasm, there is always one at least which does not thus subdivide but continues as a defined nerve fiber from the cell outward. This is believed to be the origin of the motor nerves. The above beliefs, however, as yet need substantiation in discovery.

Midway in the cerebral organ, occupying the center of the hemisphere, are two oval-shaped bodies, known respectively as the optic thalamus and the corpus striatum. Each is composed of several ganglia, the first being connected by nerve fibers with the posterior, the second with the anterior portion of the spinal chord. These, according to the hypothesis of M. Luys, are intermediate stations for the nerve currents. All the sensory nerves of the body are gathered into the ganglia of the optic thalamus, from which they are again distributed to the cerebral lobes. The return nerves from these lobes are, on the contrary, gathered into the corpus striatum, from which they are distributed to the muscles of the body. It is not necessary to give the somewhat questionable conclusions which he draws from this mechanism of the cerebral nerve system.

If now we trace the nervous system downward through the different classes of the animal kingdom, its complexity of organization is found to gradually decrease. A head ganglion, sending off nerves to the organs of special sense, is found to exist in the arthropods and the higher mollusks and annelids, but it has lost the distinctive features of the vertebrate brain. There is no longer a separate cerebral organ above, and only connected by fibers with, the ganglia which directly receive sensation and control motion. Only the analogue of the basal vertebrate brain seems to exist in these lower animals. In the Vertebrata the cerebrum may be removed without detriment to the functions of animal life, and possibly without entire removal of consciousness. In this condition a vertebrate animal may be in nervous analogy with the normal condition of the lower animals mentioned, though

from lack of dependence on its lower head ganglia, in the normal state, these possess no specialized powers of consciousness.

At a still lower level in the animal world all clear indication of nervous centralization disappears. Ganglia still exist but perhaps only as agents to draft off the sensory currents of energy to the various muscles. There probably exists a vague consciousness, but no condition that can be called psychical. The nerve system in these creatures has sunk to the level of the sympathetic in man. Still lower every trace of a nervous system vanishes, though probably continuous lines of cell protoplasm yet exist extending generally throughout the body. This condition can be traced down into vegetable life, and particularly into the Algæ, whose generalized cell substance and lack of indurated covering renders every portion of them subject to the inflow of external energy. The fibril of the cell thus seems to be the germ of the nerve apparatus of the fully developed animal.

It may be noted in conclusion that in the hypothesis of nerve development here advanced is avoided the necessity of the long and intricate explanation of nerve genesis offered by Herbert Spencer. In this view the nerve fibril is a constituent part of every cell, and the nerve and muscle function of conduction and contraction is performed by the Protozoa. In all animals of the many-celled character the protoplasmic connection between the cells functions as the primitive nerve fiber, and each cell as a primitive ganglion. Nothing further than development of this primordial apparatus is requisite as the animal race develops. And even in the most highly developed nervous system the line of its phylogeny is evident in the mode of formation of the fiber, and the character of its connection with the ganglion cell. All that is further requisite is conductive specialization, the restriction of each special impression to a special line of conduction. And natural selection has doubtless been the agent in producing this effect.

(To be continued.)

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EDITORS' TABLE.

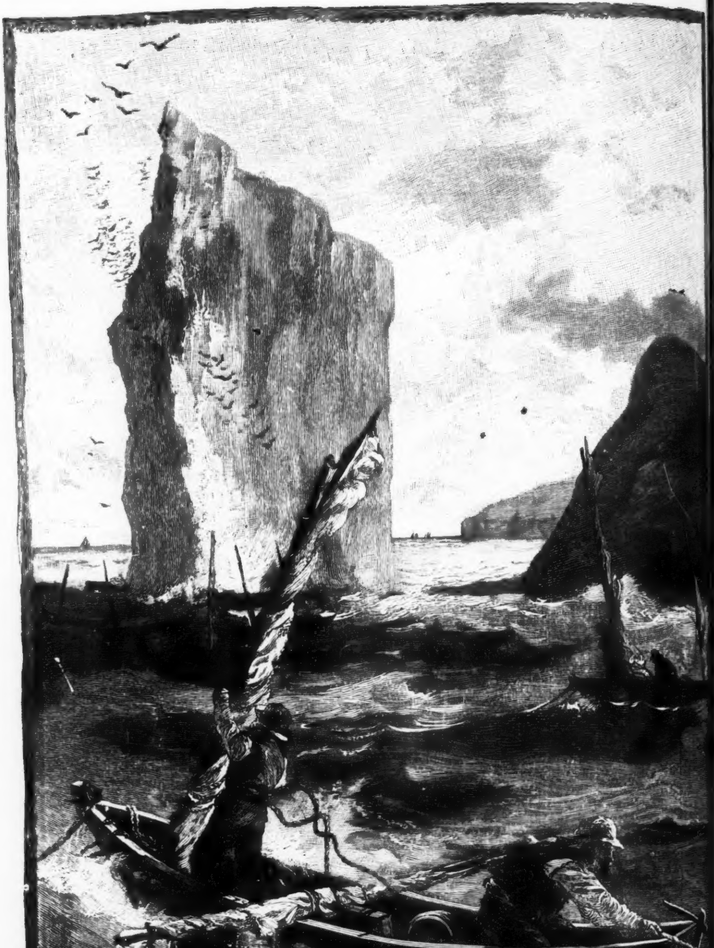
EDITORS: A. S. PACKARD AND E. D. COPE.

—— The cultivation of pure science is most successful when pursued from non-utilitarian motives. In persons who cultivate it in this way it has a sentimental as well as an intellectual origin.

Sometimes this is the desire for "more light;" in others it is the love of the beautiful in thought and in nature. In all minds it comes from brain-hunger, which may be the craving of a rational mind for a rational explanation of phenomena, or the mere necessity for grist felt by an ever-running conscious mill. To such minds money is only valuable as it enables them to satisfy these needs, and the gratification of such a mind-thirst is more to them than money can bring in any other direction. So it is with the true artist. The sensitiveness to the beautiful in nature or in idea, must find expression in proportion to its intensity, and in so doing it finds its reward. These are phases of the intellectual life which, if our race follow the usual course of evolution, are to become far more general than they are at present. It is very desirable that they should become more general, for they furnish sources of pleasure that cannot be obtained in any other way. The sentiment that loves knowledge is akin to the divine, for its sustenance is truth, and error is discarded at whatever sacrifice. It has faith enough in the order of the universe to see its innermost secrets unfolded, for unsuspicious of evil, it does not expect to find it predominant. It breathes good will to men, for it feels sure that with full knowledge evil may be avoided so as to be practically destroyed. In such a pursuit human nature is ennobled; and to respect our kind is to crown human intercourse, and to elevate social life to an ideal level.

What are the tendencies of society in this direction in our country? Is it not time to repeat the verity that "a man's life consisteth not in the abundance of the things which he possesseth?" Does the accumulation of material property constitute the highest achievement of the human mind? Does the care of the appurtenances of mere living constitute the noblest occupation of man? An affirmative would seem to be the verdict of the present generation in many places. We hope this state of things may not last. The hunger and thirst of the full-grown soul will demand satisfaction, and will some day fling aside the less worthy ideas which its larval stage have imposed upon it. It will more and more emerge into a fuller understanding of its relations to the universe, and a corresponding appreciation of its privileges and its duties. To such persons life has a worth which material possessions cannot give. Nothing on all the varied face of nature is devoid of meaning. Our fellow beneficiaries of the great realm

PLATE XXI.



Percé Rock.

of life acquire a new interest in our eyes. The nobility of man becomes more evident, and the repugnance to all that is out of accord with the evident design of the processes of evolution becomes habitual. For those who still remain in primitive conditions of thought such can labor and wait, well knowing how glorious is the harvest. To those who do not love to learn they can say with charity, "forgive them, they know not what they do;" since for them the harvest will be poor in flowers and fruit, and rich in weeds and thorns.

What are the facilities in the United States for sustaining a class of original investigators; a class whom many praise, but whom few think of as requiring unencumbered time for their work? In spite of the fact that this land was settled by idealists and thinkers in their way, we are behind the old world in the means and methods of making a life of scientific work even respectable. Professorships are mostly encumbered with work. Positions for pure research are very few. Of prizes, honorary and financial, we have scarcely any. The positions in the gift of our societies are nearly all to be obtained by political methods only, to which the true student is of necessity a stranger.

If there be no opportunities or rewards for the scientific specialist in this country, we will have to look abroad for the stimulus to thought, and for a sentiment to offset universal sordidness.

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RECENT LITERATURE.

THE CRUISE OF THE "ALICE MAY."[1]—When a yachtsman is a good story-teller and artist, and he sails through waters rich in historic and scenic features, and moreover when his publishers give him *carte blanche* to reproduce his sketches in a style unsurpassed, with the accessories of luxurious paper and presswork to correspond, the results can be safely predicted. The Gulf of St. Lawrence is a royal region for the explorer and tourist. Ever since its discovery by Jacques Cartier, and probably before his time, Basques, Bretons, Englishmen and Spaniards have fished in its waters, and hunted walrus on its islands; while antiquarians, geologists and naturalists have in later times explored every recess. The bold shores of Nova Scotia, the naked coast of Newfoundland recalling the bare coast of Spain; the low red shores of Prince Edwards island, the lonely isolated cliffs of Bird rocks and the sullen, frowning crags of the Labrador coast—what variety, what adventure, what rich gleanings in all fields of healthful sport and science await the summer cruiser in this grand gulf! And now comes the artist who crowns the whole with a series of pictures of life and nature on the shore and wave. With what

[1] *The Cruise of the Alice May in the Gulf of St. Lawrence and adjacent waters.* With numerous illustrations. Reprinted from *The Century* magazine. By S. G. W. BENJAMIN. New York, D. Appleton & Co., 1885. Sm. 4to, pp.

success Mr. Benjamin has rendered two of the grandest scenes may be seen by a glance at the two plates, for copies of which we are indebted to the publishers of *The Century* magazine.

Chartering a schooner at Prince Edwards island, Mr. Benjamin and his party sailed up the mouth of the Miramichi river, thence to Bay of Chaleur, thence north to Cape Gaspé, then visiting the Magdalen islands he crossed the Newfoundland coast, ascending the Humber river. He then visited the Island of St. Pierre on the southern coast of Newfoundland, finally crossing over to Cape Breton and taking the inside passage through the Little and Great Bradore lake; then passing through the Gut of Canso, the party left their schooner, the voyage completed, at Georgetown, P. E. I.

Our naturalist readers will be interested not only in the descriptions of the scenery, but also in the accounts of the fisheries and particularly the squid fishing as carried on at the Miquelon island. Mention is made of a peculiar breed of dogs at Arichat, Cape Breton. "They are," says our author, "like Newfoundland dogs, large, black and shaggy, but some waggish fate has robbed them of their tails, leaving only a shortish stump." The breed is said to be peculiar to Arichat, and we wish it had been ascertained through how many generations it has been in existence.

A good many tourists will want to follow more or less closely the wake of the *Alice May*, and will be compelled to take with them as a guide book this breezy, richly illustrated narrative of the cruise.

IRVING'S COPPER-BEARING ROCKS OF LAKE SUPERIOR.[1]—This volume is an elaborate account of a series of rocks whose age and relations have been much in dispute. The subject is treated largely from the lithological standpoint, and is richly illustrated by colored plates of microscopical sections and by elaborate geological maps. Professor Irving adopts the view published in the third volume of the Geology of Wisconsin in 1880 as to the pre-Cambrian age of the copper-bearing rocks, "which are in Northern Wisconsin found to be separated from the basal fossiliferous Cambrian sandstone of the Mississippi valley by a great supervening erosion, while from the underlying Huronian the separation did not appear to be so great." In that report these rocks were described under the name of the Keweenaw or Keweenawan series, following the previous suggestions of Hunt and Brooks, and this term is adopted by Professor Irving.

The report appears to have been prepared with care and ability, and is a most important contribution to theoretical as well as economic geology.

[1] *U. S. Geological Survey*. C. King, director. The Copper-bearing rocks of Lake Superior. By ROLAND D. IRVING. Washington, D. C., 1883. 4to, pp. 464.

PLATE XXII.

Cape Gaspé.

Fishing-houses at Cape Gaspé.

THE MICROSCOPE IN BOTANY.[1]—This edition and translation differs in many important respects from the original, having been especially adapted by the American editors to the wants of botanical students in this country. The changes are most numerous in chapter I, which is devoted to a discussion of the microscope. Here the student will find much valuable and interesting matter. We cannot refrain from quoting, for the benefit of our makers of microscopes as well as the younger botanists, the remark of Hugo Von Mohl: "The simpler the construction of the microscope is, the more easily and more quickly will one accomplish all the necessary movements. The more complicated the construction the more will they cost in time and reflection, and the more will the attention be distracted thereby during the observation. Whoever has not the manual dexterity to work with a simply constructed microscope, and finds it necessary to use a screw instead of his fingers for every movement, is on that account disqualified for a microscopical observer, for he will labor in vain to prepare a usable specimen" (p. 8).

The second chapter is devoted to accessories, and the third to the preparation of microscopic objects, both of which pertain to microscopy in general fully as much as to micro-botany.

Chapter IV is devoted to the reagents to be used in the botanical laboratory. The treatment here is satisfactory, and reminds one much of Poulson's Botanical Micro-Chemistry.

In chapter V we find the book proper, to which all the preceding chapters have been accessory and preparatory. Here are taken up the various substances to be found in the plant, *e. g.*, cellulose, including wood and cork, starch, dextrine, mucilage, gum, inulin, sugar, albuminous matter, chlorophyll, the coloring matter of flowers, etc., etc. In all this portion of the book the treatment is such that the student cannot fail to obtain many useful suggestions and hints in his work.—*Charles E. Bessey.*

THE AMATEUR NATURALIST, Germanton, Phila.; THE HOOSIER MINERALOGIST AND ARCHÆOLOGIST, Indianapolis; THE MUSEUM, Philada.; THE YOUNG MINERALOGIST AND ANTIQUARIAN, Wheaton, Illinois.—These periodicals are intended for the instruction and pleasure of the younger naturalists, and we welcome them as a useful agent in developing the taste for science which is so frequently seen among boys. Such publications serve to keep alive an interest which is often more or less extinguished with advancing years and responsibilities, but which is of much value to the possessor. A more general adoption of the scientific or positive method in thought and action is one of the anticipations of those

[1] *The Microscope in Botany.* A guide for the microscopical investigation of vegetable substance. From the German of Dr. Julius Wilhelm Behrens. Translated and edited by Rev. A. B. HERVEY, A.M., assisted by R. H. WARD, M.D., F.R.M.S. Illustrated with 13 plates and 153 cuts. Boston, S. E. Cassino & Company. 1885, pp. xvi, 466. $5.

that believe in progress; and these scientific journals for the young are one of the agencies by which this state of things is to be brought about.

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GENERAL NOTES.

GEOGRAPHY AND TRAVELS.[1]

AFRICA.—*The Sahara.*—Dr. Oscar Lenz has published his work on "Timbuktu" and is preparing to set out on a new expedition. His exploration of 1879–80 comprised (1) Marocco and the Atlas ranges as far as the Draa basin, and (2) the Western Sahara. Dr. Lenz traveled with only two interpreters and a trusty Maroccan attendant, yet thanks to a letter of recommendation from the Sultan of Marocco, and his assumption of the character of a Mussulman physician, he passed safely through the fanatical tribes on the route. The stony and sandy tracts of the Western Sahara are produced by the weathering of sandstone, quartz and carboniferous limestones, and have a mean elevation of from 800 to 1000 feet. Dried-up watercourses, with deep eroded channels, radiate from the central highlands north and north-east to the Mediterranean, east to the Nile, south to the Tsad and Niger, and west to the Atlantic. The conclusion seems to be that up to comparatively recent times the Sahara was a well-watered and wooded region, mostly inhabited by pastoral and agricultural communities, the descendants of more primitive peoples who were contemporary with Palæolithic and Neolithic man elsewhere. In the Taudeni district, about 20° N., under the meridian of Timbuktu, Dr. Lenz found some well-worked greenstone implements. Gerhard Rohlfs has found similar objects as far east as the Kufara oasis south of Tripoli. The Asiatic camel is a comparatively recent intruder. The crocodile still survives in many of the pools and lakelets which here and there mark the course of mighty streams. Dr. Lenz believes the desiccation to have taken place during the historic period, and attributes it largely to the reckless destruction of the woodlands. As vegetation disappeared so did moisture, the large fauna became extinct, and the settled populations were succeeded by nomad Berbers and Semites. The fortifications of Timbuktu were razed upon its capture by the Fulahs in 1826, and since then it has been a purely commercial town, but a constant bone of contention between the Tuariks and the Fulahs, which levy dues but leave the administration in the hands of the Kahia. Dr. Lenz affiliates the Fulahs to the Nubas, but A. H. Keane, in his review of the work, in *Nature*, considers this an error. The Fulahs are distinctly non-Negro, and Dr. Lenz notices the resemblance to Europeans of full-blood specimens.

M. Giraud's Expedition.—M. V. Giraud, in his account of two years among the Central African lakes, delivered before the Geo-

[1] This department is edited by W. N. LOCKINGTON, Philadelphia.

graphical Society of Paris, states that his strongest impression is the state of extreme misery in which the natives live, a misery due partly to their own laziness, but partly to the sterility of the soil. The harvest is in June, but in three months the crop is consumed, and during the rest of the year they live on wild honey, roots, fungi and wild fruits. At this season the paths are strewn with corpses. M. Giraud believes that the population is always decreasing. The only two metals found were iron and copper. It must be remembered that M. Giraud had a most discouraging experience.

Recent Acquisitions of Spain.—Spain has recently acquired considerable territory in Africa, comprising the west coast of the Sahara between Cape Bogador (20° 9′ N.) and Cape Blanco (20° 45′ N.), both included; and in the Gulf of Guinea the coast line from the Muni river, which forms the northern boundary of the French possessions on the Gaboon, to the Rio Campo (0° 43′ to 2° 41′ N.). Six stations have already been established on the Sahara coast, and all points giving access to shipping will be permanently occupied. Old treaties with the chiefs on the Rio Benito have been renewed, with a view to prevent the threatened advance of the French in that direction.

The Kingdom of the Congo.—The limits of the new "Kingdom of the Congo," as recognized by the late Berlin conference, appear to be as follows: On the Atlantic seaboard from Banana point to Yabé (5° 45′ S. lat.), then by one parallel of Yabé to the meridian of Ponta da Lenha, by this meridian north to the Chiloango, then to the source of that river, thence to the Mtombo-Mataca falls of the Congo, leaving to the French the station of Mboco, but reserving Mucumbi and Manyanga, then along the Congo to its confluence with the Bumba beyond the equator, where the boundary running north-west remains to be determined. The southern frontier follows the Congo from Banana to a point a little above Nokki, the south bank belonging to Portugal, then on the parallel of Nokki to the Qwango, along this river to about 9° S. lat., and thence in a diagonal line across the continent to Lake Bangweolo. Eastwards the boundary coincides with the west coasts of lakes Bangweolo, Tanganyika, Muta-Nzighe and Albert Nyanza. Within these limits the new State will have an approximate area of 1,000,000 square miles and a population of probably 40,000,000, mostly of Bantu speech and Negro or Negroid stock.

The Red Sea Coast.—Sir R. W. Rawson (Proc. Roy. Geog. Soc., Feb., 1885) contributes a long and learned article upon "European Territorial claims on the coast of the Red sea and its southern approaches." Many facts in the history of Abyssinia are given, and the grounds of the various claims discussed. The truncated triangle of lowland between Abyssinia and the Red sea

does not seem to have ever been practically in the hands of Abyssinia, and the rule of Turkey and Egypt has been nominal. According to the "Geographie Universelle," of Reclus, the area of this tract is about 54,000 square miles, and its population about 300,000. It is practically a desert, and its inhabitants are the nomad Danakil and other similar tribes. There is very little water, the chief river being the Hawash, which runs into lake Aussa, and then forms a brackish lake called Abhebad, about sixty-five miles from Tajura. The stream issuing from this lake fails to reach the sea, and terminates thirty-six miles from Tajura. Obock, the French possession outside the straits of Bab-el-Mandeb, has sixty-two miles of coast, and an area of 1470 square miles. It has not as yet any attraction for settlers, since it is without water, cattle, or vegetables. The first can, however, be procured from the Hawash basin, and cattle can be brought from Somali-land. The real drawbacks are the situation and character of the harbor and its position fifty or sixty miles from the route to India and the East. Sagallo, thirty-seven miles from Obock, has also been ceded to France by the local sultan. This place lies on the road from Ankober, the capital of Shoa, to Tajura, the chief place of export of King Menelik's country. King Menelik, according to M. Bramond, dreams of railroads through his dominions, and of steamers on the Hawash to Lake Aussa.

The territory of Assab, now in the hands of Italy, includes the bay of that name, with all its islands and the coast line from Ras Darmah, the eastern point of the Bay of Beilul, in N. lat. 13° 14′ to Ras Sintiyar, the south-east point of the Bay of Assab, in N. lat. 12° 53′. The belt of territory purchased from the local sultans by Italy is from two to six miles wide and thirty-five miles long.

African News.—From the remarks of Mr. J. M. Cook, who has recently returned from Dongola, it appears that the cataracts of the Nile are not correctly placed upon the map. The so-called third cataract at Hannek is no cataract at all, only a very small rapid. Between the second and so-called third cataracts four or five cataracts occur, and these explain the delay in the concentration of the British troops at Dongola. From Sarras to Sakarmatta (seventy-four miles), the rise was 450 feet.——A fresh expedition in Somali-land has been undertaken by Messrs. F. L. and W. D. James, who writes from Berbera that they intend to traverse the Habr Gerhajis's country to Lebiholii, whence five days over the desert will bring them to Ogaden. They have a guard of seventeen Somalis collected at Aden.——The map of Africa, on a scale of twenty-seven geographical miles to the inch, in course of publication by the *Depôt de la Guerre*, will consist of sixty sheets. Twenty-four of these have been published, eighteen of West and Central Africa, six of South Africa and Cape Colony. Sheet 9 shows the Canaries and the sterile country called by Dr. Barth "Tiris el Ferar,"

or the country of deep wells; sheet No. 10 gives the western half of the Sahara, and shows the routes of travelers, with many notes on the inhabitants, nature of the country, and position of the oases and wells and sheet No. 11 has a portion of the Ahaggar region, of which little is really known, and the better known Tuat oasis——M. Giraud has finally been compelled to desist from his attempted explorations. His men deserted him, retaining the French flag and Chassepôt rifles, and turned highwaymen on their way back to Zanzibar, where they were cast into prison by the French consul.——Major Serpa Pinto is at Mjuani, on the shores of the fine harbor of Nakala, which extends inward from Fernão Veloso bay.——M. F. S. Arnot has sent to the Royal Geographical Society a sketch-map of his route from Shoshong to Bihé. He followed the Zambesi, from his point of crossing, a little above Victoria falls to Lialui, from which he proceeded west-north-west to the great plateau on which Bihé is situated.——Petermann's Mittheilungen (31 Band, 1885, III) contains a map of Zululand and the gold fields of the South African republic, with a description. The previous issue gives a chart of Stellaland.

GEOLOGY AND PALÆONTOLOGY.

Sir William Dawson on the Mesozoic Floras of the Rocky Mountain region of Canada.[1]—In a previous memoir, published in the Transactions of the Royal Society of Canada, Vol. I, the author had noticed a Lower Cretaceous flora consisting wholly of pines and cycads, occurring in the Queen Charlotte islands, and had described a dicotyledonous flora of Middle Cretaceous age from the country adjacent to the Peace river, and also the rich Upper Cretaceous flora of the coal formation of Vancouver's island—comparing these with the flora of the Laramie series of the Northwest Territory, which he believed to constitute a transition group connecting the Upper Cretaceous with the Eocene Tertiary.

The present paper referred more particularly to a remarkable Jurasso-cretaceous flora recently discovered by Dr. G. M. Dawson in the Rocky mountains, and to intermediate groups of plants between this and the Middle Cretaceous, serving to extend greatly our knowledge of the Lower Cretaceous flora, and to render more complete the series of plants between this and the Laramie.

The oldest of these floras is found in beds which it is proposed to call the Kootanie group, from a tribe of Indians of that name who hunted over that part of the Rocky mountains between the 49th and 52d parallels. Plants of this age have been found on the branches of the Old Man river, on the Martin creek, at Coal

[1] Read before the Royal Society of Canada, May, 1885.

creek, and at one locality far to the north-west on the Suskwa river. The containing rocks are sandstones, shales and conglomerates, with seams of coal, in some places anthracitic. They may be traced for 130 miles in a north and south direction, and form troughs included in the Palæozoic formations of the mountains. The plants found are conifers, cycads and ferns, the cycads being especially abundant and belonging to the genera Dioonites, Zamites, Podozamites and Anomozamites. Some of these cycadaceous plants, as well as of the conifers, are identical with species described by Heer from the Jurassic of Siberia, while others occur in the Lower Cretaceous of Greenland. The almost worldwide *Podozamites lanceolatus* is very characteristic, and there are leaves of *Salisburya sibirica*, a Siberian Mesozoic species, and branches of *Sequoia smittiana*, a species characteristic of the Lower Cretaceous of Greenland. No dicotyledonous leaves have been found in these beds, whose plants connect in a remarkable way the extinct floras of Asia and America and those of the Jurassic and Cretaceous periods.

Above these are beds which, with some of the previous species, contain a few dicotyledonous leaves, which may be provisionally referred to the genera Sterculia and Laurus; and still higher the formation abounds in remains of dicotyledonous plants of which additional collections have been made by Mr. T. C. Weston. The beds containing these, though probably divisible into two groups, may be named the Mill Creek series, and are approximately on the horizon of the Dakota group of the United States geologists, as illustrated by Lesquereux and others. The species are described in the paper, and differ for the most part from those of the Dunnegan group of the Peace river series, which is probably of the age of the Niobrara group, and, of course, still more from the overlying Laramie group. With regard to the latter, the author adduced some new facts confirmatory of his previously expressed view as to the position of the Laramie at the top of the Cretaceous and base of the Eocene, and also tending to show that some of the plants still held by certain palæo-botanists to be of Miocene age are really, in Canada at least, fossils of the Laramie group, and consequently considerably older than is currently supposed. The collections of plants studied by the author had, for the most part, been placed at his disposal by the director of the Geological Survey.

The Syncarida, a group of Carboniferous Crustacea.—The following are the conclusions of a paper read at the last meeting of the National Academy of Sciences. The genus Acanthotelson of Meek and Worthen was by them doubtfully referred to the Isopoda though stated to bear some resemblance to the lower Decapoda. After describing the fossils from specimens kindly loaned by Messrs. R. D. Lacoe and J. C. Carr, we arrived at the

following results of a reinvestigation of the characteristics of the genus:

What we should regard as the differential characters of the group Syncarida, to which Acanthotelson belongs, are the sixteen free segments of the body which are homonomous or of uniform size; the first and second, however, being soldered together and forming the head; the absence of a true carapace; the seven pairs of schizopod-like legs, the first pair spined and raptorial, slightly reminding one of those of Squilla; the antennæ of both pairs being long and slender, the two flagella of the first pair being very unlike any sessile-eyed or edriopthalmatous crustacean; the six pairs of abdominal feet, which are long, slender and with a general resemblance to those of the Schizopoda; the broader, oar-like, swimming ramus ending in long setæ. Any doubts as to the macruran affinities of the Syncaridæ are removed by an examination of the telson and the last pair of abdominal appendages, with the long acute telson; the appendages are biramous, the divisions flattened from above downwards, so that they, with the telson, serve as in schizopods and shrimps for propelling the body backwards when the animal is disturbed.

We should regard the Syncarida as the lowest group of Thoracostraca, but much nearer the Schizopoda than the Cumacea; they form a connecting link between the Amphipoda and Thoracostraca, but at the same time in their most essential characters are much nearer to the schizopods than the Amphipoda. The lack of a carapace, even a rudimentary one, and the homonomous segmentation cause them to bear a resemblance to the Edriopthalmata which they would not otherwise present.

To the Isopoda Acanthotelson presents a superficial resemblance, due to the slightly vertically-compressed body and the homonomous segmentation. The Edriopthalmata (Arthrostraca of some late authors) are defined by Claus as " Malacostraca with lateral sessile eyes, usually with seven, more rarely with six or fewer separate thoracic segments, and the same number of pairs of legs; without a carapace; but this does not express those differences in the form of the antennæ the thoracic legs and abdominal appendages especially those of the end of the urosome or abdomen, which are characteristic of the sessile-eyed Crustacea as distinguished from the Thoracostraca.

From the Isopoda in which the body is usually broad and vertically flattened, with seven free thoracic segments, while the abdominal legs are lamellar and closely appressed to the short abdomen, our Acanthotelson plainly differs in the long biflagellate decapod-like first antennæ; in the long homonomously ringed abdomen and schizopodal abdominal feet and especially the schizopod-like telson and last pair of feet, adapted as in the shrimps for striking the water from above downwards.

The Amphipoda are in general characterized by their laterally

compressed body with lamellate gills on the thoracic feet and an elongated abdomen, of which the three anterior segments bear the swimming feet, while the three posterior has posteriorly directed feet adapted for springing (Claus). Now if Acanthotelson is not an isopod, still less should it be regarded as related to the Amphipoda. The first antennæ are entirely unlike those of any known amphipod, in which there is a very short accessory flagellum; the second antennæ of Acanthotelson are strictly decapodous in appearance and very different from that of the Amphipoda, whereas in Gammarus the scape is as long as the flagellum. Although there are seven free thoracic segments in Acanthotelson as well as in Gammarus and other Amphipoda, those of Acanthotelson are not compressed any more than in the Schizopoda, and there are no traces of epimera; on the contrary the free edges of the thoracic and abdominal segments are much as in the Schizopoda and Caridea. The thoracic appendages of Acanthotelson are on the whole like those of the Stomapoda and Schizopoda. We cannot detect any traces of mouth parts, mandibles, with their palpus or maxillæ, etc., but the thoracic legs do not present any close resemblance to those of the Amphipoda, the first pair being as much if not more like those of Squilla than any amphipod with which we are acquainted, while the three posterior pairs which are in form and size like those in front, entirely differ from those of Gammarus and most other normal amphipods in which the basal joint is very large and triangular. Turning to the abdomen the differences of that of Acanthotelson from that of the amphipods is still more marked. The first five pairs of uropoda or abdominal appendages are in Acanthotelson all formed apparently on the same plan, not essentially different from those of schizopods, while the last pair are flat and on the same plane as the telson and intimately associated with the latter, in that these parts are formed on a truly macrurous plan and most approach those of the schizopods, in which the telson and rami of the last pair of feet are narrow and more or less acute at the end. There is nothing in the structure of the urosome and its uropoda in Acanthotelson to remind us of the same parts in the Amphipoda.

Excluded from the sessile-eyed Crustacea, and forced to place Acanthotelson in the Thoracostraca, we are confronted by the lack of a carapace, and the homonomous segmentation of the body. These are essential, fundamental characters, but still the nature of the appendages and telson is such as to forbid us from rejecting the Syncarida from the ordinal limits of the Thoracostraca. We are compelled to regard the group as a suborder standing near or at the base of the Thoracostraca, not far from the Stomapoda and Schizopoda, and with appendages closely homologous with those of these two groups. The Syncarida, in their lack of a carapace and in the well-formed dorsal arch of the seven thoracic segments, we are obliged to consider as

an annectant group, pointing to the existence of some extinct group which may have still more closely connected the sessile-eyed and stalk-eyed Crustacea.—*A. S. Packard.*

Marsh on the Dinocerata.[1]— This work, which has been announced for some time, is now before us. It is one of the quarto series of the United States Geological Survey, but the present edition was published, we are informed, by the author at his own expense. The mechanical execution of the book is good, and it will remain a monument to its authors. We confess, however, to surprise at not finding it, as we had anticipated, a monograph of the group. According to the synopsis of twenty-nine reputed species, which forms the last part of the volume, a great deal of material representing them has been obtained by Professor Marsh, but we have searched in vain for a description of the greater part of it in the work. The memoir is in fact of a rather general character, giving descriptions of the osteology of the two species *Loxolophodon mirabile* and *L. ingens*,[2] with occasional references to others. It is evident that the greater part of the work of writing this monograph remains to be done. We should have preferred to have seen this magnificent opportunity improved, so that it should have embraced detailed descriptions of those characters of all the species on which alone the derivation theory can be established or refuted. A natural result of this neglect is a failure to appreciate the true generic relationships of the species. There are no sufficient characters adduced for the generic discrimination of the species included under the heads Dinoceras and Tinoceras, while the characters of Uintatherium are erroneously given. The distinct genus Bathyopsis is not admitted, and there are two distinct genera, represented by species described by Professor Marsh, which are not recognized.[2]

Professor Marsh thinks that the females of these animals had shorter canine teeth than the males, and that the protective mandibular flange is correspondingly small in that sex. He also finds variation in the nasal tuberosities, and indicates that these also are larger in male animals.

In connection with the description of the brain of the Dinocerata, Professor Marsh gives us much new valuable information as to the brain characters of a number of extinct ungulates. He, however, fails to give Professor Lartet credit for the proposal of the general theory of brain development in the Mammalia with the progress of geological time.

The classification of the Ungulata adopted is largely that of Cope, to whom no acknowledgment is made. A hypothetical group is proposed and defined as the primitive type of Ungulata.

[1] The Dinocerata. By O. C. Marsh.

[2] For the genera of Dinocerata, see Naturalist, June, 1885.

Professor Marsh is apparently not aware that this group has been actually discovered, defined and extensively illustrated under the name of Condylarthra by Cope, and that its discovery was anticipated on hypothetical grounds by the same author as long ago as 1874.[1] The unwary reader may be still further impressed with the idea that all this is new, by the array of new names which are attached to these well-known natural divisions. The Condylarthra figure under another name, and those of Amblypoda and Pantodonta are changed on the pretext that they are preoccupied, though Professor Marsh does not state when or how. Careful examination has failed to reveal any real preoccupation. The nearest name to Pantodonta is Pantodon, a genus of fishes, and to Amblypoda is Amblypodia, an unused synonyme in Lepidoptera. We do not believe, however, even were the names identical, that a generic name can be preoccupied by the name of an order, or other mononomial word, or *vice versa*. The name Diplarthra (the Ungulata of Gill and Flower) is changed for a new one, and other terms are employed for the time-honored and generally used Perissodactyla and Artiodactyla of Owen. We forbear comments, remarking only that even a handsome volume like this one will not suffice to obliterate history.[2]

On p. 169, one is surprised to read the following statement: "No Cretaceous mammals are known." Two species were described from the Laramie Beds of Dakota, two or three years ago.

Professor Marsh corrects by implication a good many errors made by himself several years ago when criticising the work of another author on this group. Thus he adopts the species *Loxolophodon cornutus* Cope, and no longer considers it identical with a species subsequently described by himself. But he cannot avoid making a misrepresentation as to a photograph of this species of which a few copies were circulated at the time of its discovery. The statement that the canine tooth was attached to the skull by a plaster base so as to increase its apparent length is erroneous. The tooth was made to adhere to its base by a piece of paper which took white in the picture, and which Professor Marsh takes for granted was plaster. The reproduction of this photograph in Professor Marsh's book instead of some of the good figures which have since appeared, is apparently designed to substantiate this statement. Professor Marsh, moreover, does not recede from the erroneous position he took at that time on the question of nomenclature, but still uses generic names which have been repeatedly shown to have no right to exist if the ordi-

[1] Journal of the Academy of Natural Sciences Philada. Proceedings do, 1873, Nov. 13th.

[2] See AMERICAN NATURALIST for Nov. and Dec., 1884, and Jan., 1885, on the Amblypoda.

nary rules of nomenclature are observed.[1] The history of the subject is concealed from the reader by the omission of reference in their proper places to the papers which antedate those of Professor Marsh, and by the omission of the dates of their publication when they are referred to.[2]

This work will always be valuable for the descriptions and plates which it contains, and with the abatements we have already pointed out, we recommend it as the handsomest work on the subject yet published.—*E. D. Cope.*

Geological News.—*General.*—From a paper recently read by W. H. Hudleston at the meeting of the Geologists' Association it appears that the "Nubian sandstone" comprises the strata between the crystalline rocks and the Upper Cretaceous; the lower sandstone and overlying limestone of Wady Nasb is Carboniferous; the middle division is Cenomanian, is widely extended in Egypt, occurs in great force at Petra, and constitutes the cliffs on the east side of the Dead sea; while the Lebanon division is probably well up among the Cretaceous limestones and possibly on the horizon of certain ligniferous beds occurring at Edfou on the Nile. The crystalline rocks are in two series, a lower (referred to the Laurentian) penetrated by dykes of granite and diorite; and a second series consisting mainly of porphyries permeated by dykes of feldspar and basalt. All the Nile cataracts occur where the river passes over such crystalline areas, while the tranquil stretches are upon the Nubian sandstone. The Cretaceous limestones are in Syria more important than those of Eocene age, but in Egypt the latter are much the thickest. The Cretaceous beds in Egypt are much less calcareous than those of Palestine, and abundance of rocksalt, gypsum and bitumen is noted on certain horizons (Zittel). Neither in Palestine nor in Egypt is there any sharp line of demarkation between the chalk and the Tertiary rocks. The celebrated Jebel Usdom or Salt mountain of the Red sea, is assigned to the Cretaceous by Dr. Lartet, but to the marls of the Dead Sea basin by Hull. Zittel states that the palæontological boundary between the chalk and the Eocene is clearly defined, despite the continuity of the marine deposits. The Dead sea hollow is undoubtedly an independent lake basin of high

[1] We take the present opportunity to refer to some similar cases of hypersensitiveness to be found in Professor Marsh's papers on the Dinosauria. The genus Megadactylus was named by Dr. Hitchcock, in 1865, from specimens from the Trias of Connecticut, but was not defined. It was defined by Cope in 1870. Professor Marsh changes the name because it had already been used by Fitzinger for a genus of lizards. But Fizinger's name is an undoubted synonyme of a well-known form, and has no status whatever. We hold that the change of name is unwarranted. The name Lælaps is also discarded for another, because the name Lelaps is used for a genus of Hymenoptera. The names are not identical, and there is no preoccupation. On the same principle Dinoceras should give way to Tinoceras of earlier date, as they differ by but a single letter, were not both names really synonymes of a still older one.

[2] See the Bibliography, p. 225.

antiquity. The watershed separating it from the southern portion of the Arabah is 660 feet high, while the highest point of the Vale of Jezreel is only 285 feet. Marl deposits exist in the Dead sea basin at an elevation of 1400 feet above the present Dead sea level, and the old marls of the Jordanic lakes are not entirely unfossiliferous, as three Melanidæ have been found in them.

Silurian.—Figures of the now celebrated fossil scorpions found in the Silurian rocks of Scotland and Gothland by Dr. Hunter and Professor Lindstrom, are given in *Nature* (Jan. 29), and Mr. B. N. Peach gives in the same number a compendium of our knowledge of these ancient air-breathers. The first Paleozoic scorpion found was described in 1835, by Count Sternberg, from a specimen obtained in the coal formation of Chonile, near Radnitz, in Bohemia. Three years later Corda described another (Microlabis) from the same locality. In 1866 Messrs. Meek and Worthen described two new species from the Coal Measures of Mazon creek, Illinois. In 1873, Dr. H. Woodward showed that the genus Eoscorpius (one of those found at Mazon creek) occurs in the English Coal Measures and in the Carboniferous limestone of Scotland. In 1881 Mr. Peach examined a large series of scorpions from the lowest Carboniferous of the Scotch border, and described (Trans. Edinb. Roy. Soc.) several species of Eoscorpius, with the remark that Meek and Worthen's name was unfortunate, since the dawn of the scorpion family must have been much earlier. Although Dr. Hunter's specimen was the last announced, it was obtained a year before the discovery of the Gothland specimen. It agrees with the latter (*Palæophonus nuncius*) in having pointed thoracic feet, unlike those of Carboniferous times and of the present age. Mr. Peach asks, What were the victims of these ancient murderers? The dragon-flies of the Middle Devonian of New Brunswick were thought to be the oldest land animals until Mr. Peach, in 1882, showed that chilognathous myriapods were far from uncommon in the Lower Old Red Sandstone of Forfarshire, in Scotland. There is but a short step from this to the Silurian, and M. Brongniart has found in the Silurian limestone of Calvados a fossil Blatta. Perhaps a habit of feeding on the eggs of animals left bare by the tides may account for the embedding of these air-breathers in marine strata.

Devonian.—*Hystricrinus carpenteri*, a crinoid with articulating spines, is described by G. J. Hinde in the *Ann. and Mag. Nat. Hist.*, March, 1885. The genus is identical with Arthrocanthus (Williams), a name preoccupied among the Rotatoria. Apart from the possession of articulating spines it is near Hexacrinus. The specimens are from calcareous shales of Middle Devonian at Arkona, Ontario. It is curious that in three out of the eleven examples a shell of the genus Platyceras is attached to the vault of the crinoid.

Cambrian.—Mr. Chas. D. Walcott (*Amer. Jour. of Science*, April, 1885) describes Mesonacis, a new genus of Cambrian trilobites, intermediate between Paradoxides and Olenellus, the head and first fourteen segments being of the type of the latter, while the pygidium and ten posterior segments more resemble the former. The fifteenth segment fits snugly against the fourteenth, and has a long, slender spine extending to the pygidium. *Mesonacis vermontana* occurs in the Georgian of the State it is named after.

Carboniferous.—MM. Renault and Zeiller have described a number of mosses from the carboniferous strata of Commentry (France). The mosses previously found in a fossil state have been few, and of the Tertiary epoch, principally Miocene, but the Commentry beds contain many impressions of their stems, three or four centimeters long, some simple, others with alternate fronds. The stems are usually united in tufts. The absence of any trace of the organs of fructification prevents the determination of the place of these fossils in present classifications, but MM. Renault and Zeiller think they belong rather among the acrocarps than among the pleurocarps.——T. R. Jones and J. W. Kirkby give, in the *Ann. and Mag. of Nat. Hist.* for March, a synopsis of the species of the ostracodous genus Kirkbya, eleven in number. Most of the specimens are from marine shales associated with the calcareous beds of the Carboniferous series.

Tertiary.—Mr. J. W. Judd has shown that in the Western isles of Scotland there occur a number of peridotite rocks which are the central cones of Tertiary volcanoes of vast dimensions. These Tertiary peridotites are intimately associated with the gabbros and dolerites, and present numerous variations both in structure and mineralogical constitution. Among them occur examples of the rocks which have received the names of dunite, picrite and lherzolite.——Dr. C. J. Forsyth Major (Quart. Jour. Geol. Soc., 1885) gives a list of thirty-nine species of fossil Mammalia found in the Val d'Arno. Not one of the members of the rich fauna found in the Mediterranean region and as far east as the Siwaliks of India, and existing on the boundary line between the Miocene and Pliocene, is found in the Val d'Arno, though the two antelopes, the Machairodus and the Mastodon, are closely allied. This Mediterranean fauna occurs at Casino, near Siena, and the somewhat younger fauna of the Val d'Arno was also spread as far as India. The shore deposits of the Pliocene sea in Italy are said by Dr. Major to contain the same mammalian fauna as the lacustrine deposits of the Val d'Arno. The Post-pliocene fauna exhibits several connecting links with the Pliocene, but, in Italy at least, not a single species of the older fauna seems to have gone over, as such, to the younger fauna. Not a single species of the thirty-nine is identical with those living to-day, and five

genera—Machærodus, Mastodon, Leptobos, Palæoryx and Palæoreas—are extinct. Pliocene mammals, but little altered, yet occur in the Sunda islands; the Anoa is close to the Siwalik Hemibos, *Bos etruscus* is a Bibos, close to the Banting of Java, the Pliocene stags, tapirs and rhinoceroses are nearly repeated by the forms now living in Southeastern Asia, and *Sus verrucosus* of Java is close to the Pliocene *Sus giganteus.* Professor Boyd Dawkins believes that two of the deer of the Pliocene of the Val d'Arno, as also the Hippopotamus, are identical with existing species.——A before unknown deposit of Pliocene age at St. Erth's, near the Land's End, Cornwall, has yielded fifty species of mollusks, of which all but eleven or twelve are extinct.

MINERALOGY AND PETROGRAPHY.[1]

New Minerals.— 1st. *Bertrandite.*—This mineral, mentioned by Bertrand in 1880 (Bul. soc. min. d. Fr., III, 96) as a probably new aluminum-silicate from Barbin, near Nantes, is shown by Damour[2] to have the composition $4BeO$, $2SiO_2$, H_2O, on which account he proposes for it the above name. It occurs in druses of a coarse pegmatite. Its system of crystallization is orthorhombic; axial ratio $a:b:c = 0.5619:1:0.5871$. Observed planes $0P$, ∞P, $\infty P\bar{\infty}$, $\infty P\bar{3}$, $\infty P\breve{\infty}$, $\infty P\breve{3}$, $P\breve{\infty}$, $3P\breve{\infty}$. Plane of the optical axes is $\infty P\breve{\infty}$. Principal bisectrix is $\breve{a}$. Dispersion $\rho < \upsilon$.[3]

2d. *Evigtokite* is a name applied by Flight[4] to a mineral of the cryolite group from Greenland having the composition CaF_2, AlF_3, H_2O. It is composed of masses of minute, white, transparent crystals.

3d. *Liskeardite* of the same writer occurs in layers sometimes a quarter of an inch thick, at the mines of Cornwall. It is fibrous in structure, of a white color or with a greenish or bluish tinge. Its composition is $(Al, Fe)AsO_4$, $8H_2O$. Analysis:

Fe_2O_3	Al_2O_3	As_2O_5	SO_3	CuO	CaO	H_2O
7.64	28.229	26.962	1.111	1.027	0.719	34.053

4th. *Pinnoite* is a new borate from Stassfurt described by H. Staute.[5] Its crystal form could not be determined. Sp. gr. 2.27. Hardness 3–4. Its composition is:

MgO	B_2O_3	H_2O	Fe	Cl
24.45	42.50	32.85	0.15	0.18

which gives the formula $MgB_2O_4 + 3H_2O$.

[1] Edited by Dr. Geo. H. Williams, of the Johns Hopkins University, Baltimore.

[2] Bull. soc. min. de Fr., VI, 1883, p. 252.

[3] Ib., p. 249.

[4] Journal Chem. Soc., Vol. 43, March, 1883, p. 140.

[5] Berichte der deutschen chemischen Gesellschaft, XVII, No. 12, p. 1584, July, 1884.

5th. *Avalite.*—S. M. Lasanitoch,[1] of Belgrade, gives this name to a new chromium-aluminium silicate occurring in thin green scales in the quartz of the quicksilver deposits at Avala, near Belgrade. An analysis of the purest specimen, which was, however, mixed with some chromite and sand, gave the following result:

SiO_2	Cr_2O_3	Al_2O_3	K_2O	Fe_2O_3	MgO	chromite	H_2O	loss
56.13	14.59	14.37	3.54	1.10	0.43	1.68	2.39	5.38

6th. *Zunyite.*—Mr. Hillebrand,[2] of the U. S. Geol. Survey, now stationed at Denver, Col., describes remarkable tetrahedral crystals of a new mineral which he found imbedded in an uncrystallized sulphide of lead and arsenic, occurring at the Zuñi mine on Anvil mountain, near Silverton, San Juan county, Col. These crystals are mostly very minute, rarely 5^{mm} in diameter. They show the forms $\frac{O}{2}, -\frac{O}{2}, \infty O \infty$ and ∞O or $\frac{mO}{2}$, and are quite isotropic. The smallest are clear and transparent; the larger ones dark on account of black inclusions. Sp. gr. 2.875 at 15° C. Luster glossy, cleavage octahedral, hardness 7. The mean of several analyses gave:

SiO_2	Fe_2O_3	Al_2O_3	K_2O	Na_2O	H_2O	P_2O_5	F	Cl
24.33	0.20	57.88	0.10	0.24	10.89	0.60	5.61	2.91

sum 102.76 — O for Cl and F (3.02) = 99.74.

Formula, $9R_2O, 8Al_2O_3, 6SiO_2$, with part of the O replaced by Cl and F. The black inclusions were shown to be titanic oxide.

7th. *Guitermanite.*—The metallic sulphide in which the above described crystals of zunyite were imbedded, was found to have the composition $10PbS, 3As_2S_3$, being likewise a new mineral to which the same author applies the name Guitermanite.

8th. *Koninckite.*—M. Cesàro[3] has recently described a new hydrous phosphate of iron from Visé in Belgium. It occurs in spherical groups of radiating, nearly colorless monoclinic needles associated with richellite, another new mineral lately described by the same author (vid. NATURALIST, Jan., 1884, p. 65.) Koninckite has one perfect cleavage, H = 3.5; G = 2.3. Its composition is:

P_2O_5	Fe_2O_3	H_2O	Al_2O_3 (difference)	total
38.4	33.9	26.8	4.5	100

It is named after Professor De Koninck of Liége.

9th. *Endlichite or vanadium mimetite.*—Professor Genth[4] has found that certain straw-yellow crystals occurring at the silver mines of Southern New Mexico have the composition

[1] Berichte der deutschen chemischen Gesell., XVII, No. 13, p. 1774, Aug., 1884.
[2] Proceedings of the Colorado Scientific Society, Vol. I, 1883–84, p.124.
[3] Mem. Soc. Geol. Belgique, XI, p. 247.
[4] Contributions from the Laboratory of the University of Pennsylvania, No. XXIII. Read before the American Philosophical Society, April 17, 1885.

$Pb_5 Cl (AsO_4)_3 + Pb_5 Cl (VO_4)_3$ or about equal proportions of vanadinite and mimetite. He has assigned to them the name Endlichite in honor of Dr. F. M. Endlich, superintendent of the Sierra mines at Lake valley, N. M. The same paper contains new analyses of vanadinite and a crystallographic investigation, by Professor G. vom Rath, of the New Mexican decloizite, illustrated by four figures. These crystals, which are the best ones thus far known, indicate that the mineral is orthorhombic, as was surmised by Des Cloizeaux instead of monoclinic as held by Websky. Associated with the vanadinite of Sierra Grande fine crystals of iodyrite were also found.

BOTANY.[1]

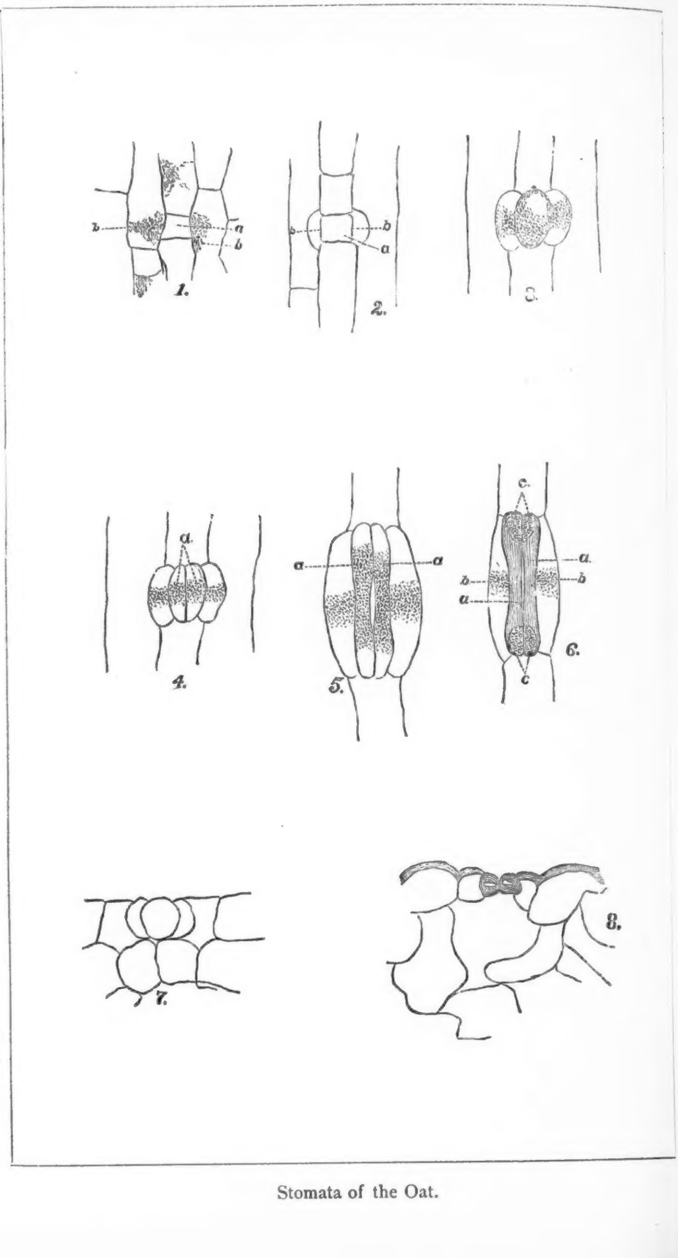
American Medicinal Plants.—We recently noticed the first fascicle of this work, by Dr. Millspaugh, as worthy of patronage. An examination of the second fascicle confirms our favorable opinion. The illustrations are very good, and will not only serve admirably their purpose of enabling the medical student to recognize the various species of medicinal plants, but they will be found of value to the teacher or student of ordinary botany. In the second fascicle there are colored plates of *Actæa spicata*, *Carya alba*, *Cephalanthus occidentalis*, *Cypripedium pubescens*, *Equisetum hyemale*, *Juglans cinerea*, *Mitchella repens*, *Thuja occidentalis*, *Viola tricolor*, etc., etc., thirty in all.

Development of Stomata of the Oat.—Before the stomata appear the epidermis is composed of quadrangular cells, which afterwards grow much faster in length than in breadth. The mother-cell of a stoma is cut off from the end of one of these cells, and sometimes each cell in a row furnishes a stoma (Fig. 1 *a*). This mother-cell rapidly increases in size, and large masses of protoplasm touching the cell soon become evident in the cells adjacent to the sides (Fig. 1 *b b*). This gathering of protoplasm is preparatory to the formation of accessory cells, which are at first nearly semicircular, and are cut out of the adjacent cells, one on each side of the mother-cell (Fig. 2 *b b*). The central and accessory cells now enlarge in about the same proportion until the former divides into two guard cells (Fig. 4); after this the accessory cells encroach upon the guard cells until in the mature stoma the latter are narrower through the center than at the ends; and the width of the whole four cells is but little more than of one single epidermal cell (Fig. 6).

The behavior of the protoplasm is very characteristic, the general rule is as follows: The mother-cell and the accessory cells are both at first full of rich protoplasm. In the accessory cells this tends to condense in the center; vacuoles first appear in the ends of the cells (Fig. 3), these increase in size with the develop-

[1] Edited by Professor Charles E. Bessey, Lincoln, Nebraska.

PLATE XXIII.



Stomata of the Oat.

ment of the stoma (Fig. 4), and in the mature stoma the visible protoplasm consists merely in a large nucleus in the center of each cell (Fig. 6 *b b*). In the mother-cell one or two vacuoles may appear in any place, one central vacuole is perhaps the most frequent form (Fig. 3), but when division takes place a band of thick protoplasm stretches across the center of the cell (Fig. 4 *a*). Instead of condensing this tends to extend through the length of the cells leaving vacuoles only in the extreme ends (Fig. 5 *a a*). In the immature stoma this protoplasm is very slightly granular and has a slight green tinge, as if chlorophyll is being formed (Fig. 5); but in the mature stoma it appears perfectly homogeneous, and small chlorophyll bodies which show the presence of starch on application of iodine, occupy the former vacuoles. A cross-section, made before the mother-cell has divided, shows very thin walls (Fig. 7), but a section of a mature stoma represents the guard cells as having thick walls, and I think it probable that most of the protoplasm has been absorbed in the thickening process (Fig. 8). This behavior of the protoplasm varies some in different stomata, especially in the stages represented in Figs. 3 and 4, but the process described prevails, and seems to be typical.

The methods of finding the different stages of development are very simple. If the leaves of a growing plant be unrolled until the youngest is reached and the base of this used, it will show the youngest forms. It is useless to attempt to remove the epidermis, for the leaves which would contain the undeveloped stomata are too tender to permit it. Soaking the young leaves in a two per cent salt solution for about ten minutes aids in showing the formation of the accessory cells, if an examination is made immediately.—*Effie A. Southworth, Bot. Lab. Univ. Mich.*

EXPLANATION OF PLATE XXIII.

× 425.

FIG. 1.—Mother-cell of stoma.
" 2.—Mother-cell and accessory cell.
" 3.—Same more advanced.
" 4.—Same with mother-cell divided into two guard cells.
" 5.—More developed stage of same.
" 6.—Mature stoma.
" 7.—Cross-section of a young stoma.
" 8.—Cross-section of a mature stoma.

THE OPENING OF THE FLOWERS OF DESMODIUM SESSILIFOLIUM.—This Desmodium, which grows abundantly in Central Iowa, presents a structural and physiological adaptation for securing pollination which is quite interesting. The purplish flowers are about 1.5 centimeters long and are arranged in pairs, racemosely upon a spreading terminal inflorescence. The keel is at first enclosed within the wings, which in turn enclose the stamens and

pistil. The standard projects forward approximately parallel with the other petals, diverging from them at a small angle (Fig. 1). The standard now begins to bend upwards and the wings and keel downwards, the resistance offered by the sepals being such as to cause the wings and keel with their contained stamens and pistil to be strongly deflexed (Fig. 2). The flower is now in a state of tension, and may be likened to a spring trap ready set for action.

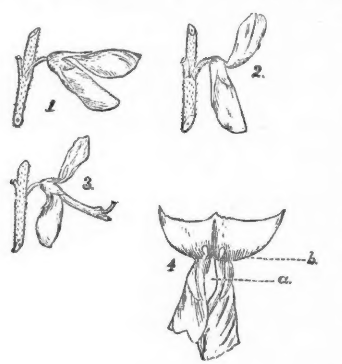


FIG. 1.—Flower when first opened; and before the petals begin to reflex. FIG. 2.—The same with the petals reflexed; the flower in a state of tension. FIG. 3.—The same after the stamens have sprung out from the wings and keel. Fig. 4.—Front view of the base of the standard (cut away above) and the bases of the wings, showing at *a* the opening to the honey reservoir, and at *b* the eye-spots. 1, 2 and 3 natural size, 4, enlarged.

A little examination will show that many of the flowers have changed the relation of their parts, the tension being in a great measure relieved (Fig. 3). A closer inspection shows that when the flower is in a state of tension, the stamens and pistil are forcibly drawn downward, as one might draw down the end of a stiff spring. Now in the later flowers mentioned above (Fig. 3), the stamens and pistil have escaped from the deflexed keel and occupy their normal position in the axis of the flower.

If we now take a flower in its state of tension and look down between the separated standard and wings, we notice upon the dark-colored base of the standard two bright yellowish-white eye-like spots which show with remarkable distinctness upon the dark background (*b* Fig. 4). Directly in front of these there is an opening left between the approximated edges of the wings (*a* Fig. 4); this opening appears to be the entrance to the store of honey. Suspecting this and also that the eye-spots had some function, I began feeling the surface of the standard and the wings and the interior stamen tube, in the vicinity of the eye-spots, using a pencil point, with the result that whenever the standard was gently pushed backwards by a touch near the eye-spots, the stamens and pistil would be freed with a violent jerk. The experiment was repeated again and again, invariably with the same result. I was not fortunate enough to observe insects "springing" these traps, but from the fact that nearly every flower upon an exposed plant eventually is thus opened, there can be no doubt that insects do spring them open. This is rendered still more certain by the

fact that flowers brought into my laboratory where they were not visited by insects, although they were kept in water, did not spring open. Repeated trials under different conditions showed that at the instant the sensitive surface was touched, the basal third of the wings and keel became strongly curved, and that this brought so great a tension upon the stamen-tube and pistil that the latter could not be held longer by the petals, as a bow when bent too far snaps its string and frees itself.

The purpose of this ingenious mechanism is obvious. When the stamens spring out with such violence they throw the pollen forcibly against the body of any insect hovering over the flower or resting upon its wings and keel.—*Charles E. Bessey.*

Botanical News. — The March and April numbers of the *Western Druggist* contain an interesting paper on plant hairs by Professor E. S. Bastin of Chicago. It is illustrated by numerous wood-cuts.——In a recent number of the *Gardeners' Chronicle* Mr. W. G. Smith furnishes an illustration of *Peronospora effusa.* It is in his well-known style, a style against which we are moved to protest vigorously. Conventionalized plant figures may be permissible in art, but certainly they are not in botany.——Recent numbers of *Flora* (Regensberg) contain a paper on the lichens of the French Jura mountains, by Dr. F. Arnold.——The most interesting paper in the May *Journal of Botany* is one by Mr. Spencer Moore upon the Identity of *Bacterium fœtidum* of Thin, with soil Cocci, in which it is shown that the bacteria which produce or accompany "the sweating of the feet" are identical with those producing chemical action in the soil. In the latter situation they reduce the sulphates to sulphites, and the phosphates to phosphites, and in both situations are instrumental in setting free ammonia.——Dr. Vasey's Descriptive Catalogue of the Grasses of the United States, just received, is a valuable contribution to the literature of our Gramineæ. The genera are described, and under each are arranged all the species which occur within the limits of the United States. A few synonyms are given, enough to enable one to use the catalogue in connection with the older manuals. A summary at the end of the volume gives the whole number of genera in the United States as 120, and of species 675. Following the catalogue proper is a synopsis of the tribes of North American grasses based upon Bentham and Hooker's arrangement in the Genera Plantarum. Two years ago the same author published a somewhat similar catalogue in which there were 114 genera and 589 species. We will repeat what we have said several times already, that work of this kind coming from the Department of Agriculture at Washington tends to raise the value of the department in the eyes of the scientific men of the country.

ENTOMOLOGY.

UNUSUAL NUMBER OF LEGS IN THE CATERPILLAR OF LAGOA.—*Lagoa crispata* Pack. is an interesting moth forming a connecting link between the Dasychiræ (Orgyia) and the Cochlidiæ, represented by Limacodes and its allies. As we remarked in our Synopsis of Bombycidæ (1864): "When we observe the larva we would easily mistake it for a hairy Limacodes larva, for like them the head is retracted, the body is short, and the legs are so rudimentary as to impart a gliding motion to the caterpillar when it moves." After describing the transformations, we added: "There are seven pairs of abdominal or false legs, which are short and thick. The first pair of thoracic or true legs are much shorter than the two succeeding pairs."

Lagoa.

Two years ago we found the fully fed caterpillars and also those before the last molt on scrub-oaks in Providence, and again noticed them while walking, then carefully examined them after placing them in alcohol, and again examined the specimens during the past winter. It is well known that caterpillars have no more than five pairs of "proplegs," "false legs" or abdominal feet, as they are variously called; and so far as we have been able to learn the present caterpillar is the only one which has additional legs, even though rudimentary. As in all lepidopterous larvæ, there are ten abdominal segments. In the larvæ before the last molt there is a pair of rudimentary abdominal legs on the second abdominal segment, forming soft tubercles about one-third as large as the succeeding normal feet; the crown of hooks was wanting, but a tubercle on the anterior side corresponding to a similar one on the normal feet had five or six well marked stout spines, also two or three scattered ones in the middle, the tubercle being rounded, convex, not flattened at the end.

On the sixth segment, following the fourth pair of normal abdominal legs, is a pair of tubercles like those on the second segment and exactly corresponding in situation with the normal legs; situated externally are two long straight spines, but none homologous with those forming the crown. At the base in front of each tubercle is a tuft of sparse hairs, and on the outside is a chitinous spot bearing a dense tuft of hairs; these two tufts precisely agree in situation and appearance with those at the base of normal abdominal legs.

In the fully fed caterpillar the tubercles are exactly the same. It thus appears that in the Lagoa larva the first abdominal segment is footless; the second bears rudimentary feet; segments 3–6 bear normal proplegs; the seventh bears a pair of rudimentary legs; segments eight and nine are footless, while the tenth bears the fully developed anal or fifth pair of genuine proplegs.

While these two pairs of tubercles differ from the normal legs

in being much smaller and without a crown of curved spines, they are protruded and actively engaged in locomotion, and in situation, as well as the presence of the basal tufts are truly homologous with the normal abdominal legs.

When we turn to the work of Kowalevsky on the embryology of Sphinx, we find that it has ten pairs of abdominal legs which arise in the same manner as the thoracic or chitinous, jointed legs. Of these ten pairs one half disappear before hatching, leaving the five pairs usually present. It seems to us that the two pairs of rudimentary legs in Lagoa are survivals of these embryonic temporary feet. Although the proplegs are not popularly regarded as true legs, they are undoubtedly so, as embryology proves. In the lower Noctuidæ, such as Catocala, Aletia, etc., the larvæ are at first geometriform, having but three pairs of proplegs; in the geometrids there are but two pairs, while in the Cochlidiæ there are not even any rudimentary feet, thoracic or abdominal. As we have elsewhere observed, the primitive lepidopterous larva must have had a pair of feet on each abdominal segment, and may have descended from Neuroptera-like forms allied to the Panorpidæ as well as Trichoptera.—*A. S. Packard.*

USE OF THE PUPÆ OF MOTHS IN DISTINGUISHING SPECIES.—In describing the pupæ of certain moths we have found it well to observe and note with care the shape and appendages of the terminal spine of the abdomen. This has been done to some extent, but our experience teaches us that there are, in a great number of cases, excellent specific or at least generic characters in these parts. In the Bombycidæ, the Notodontians especially, and in the Geometridæ as well as the Phycinæ and Tortricidæ, there are notable differences between those species which do or do not spin a cocoon, the latter attaching themselves by a mass of silk to the leaves, the spines and setæ giving them a firm hold. In those living among leaves or in the earth, the spine is provided with long curved setæ arising from the end and sides of the spines; these vary much, as does the abdominal tip in general in different species of Acrobasis, according as they live simply between leaves or in a cocoon. In some Notodontians which make a cocoon, as in *Lophodonta angulosa,* the tip of the abdomen is blunt, ending in a rounded knob, with no rudiment of a spine.

In *Dalana ministra* the obtuse tip of the abdomen is divided into a stumpy short bifid spine, each division ending in two spines, with an external shorter third minute one at base.

In *Edema albifrons* the tip proper ends in a short spine, which is flattened vertically, deeply cleft, with tubercles, from which arise 3–4 curved setæ on each side, the entire apparatus retaining a firm hold on the end of the mass of silk by which it adheres to the leaves.

In the pupa of *Lochmæus tessella* the tip is flattened vertically

and very deeply cleft, each fork ending in a short lateral excurved hook, but with no setæ. This form lives in a slight cocoon, where it has no need of hooks.

In Bombycidæ, such as *Eacles imperialis*, which enters the earth and makes no cocoon, the use of the large caudal spine is as plain as in the pupæ of the Sphinges; so also in the species of Anisota and Dryocampa.

In the Geomtrids and Tortricids there are, in the abdominal spine and hooks, excellent generic and specific characters, as I have found in different species of Teras, etc.—*A. S. Packard.*

Swarming of a Dung-Beetle, Aphodius inquinatus.—About the first of last October, while riding along a country road near Ripon, my attention was attracted to a dark mass of living matter in the road. On examination it proved to be a host of *Aphodius inquinatus*, engaged with horse dung. They were in two or three masses, whose areas averaged perhaps three square feet each, and were piled up two or three deep. So many, too, were flying about in the air that as I rode along I could, with a single motion of the hand, catch from two or three to half a dozen. Nor were they confined to this one place, for they appeared in considerable numbers at a distance of at least a mile from the point at which I first noticed them.—*C. Dwight Marsh, Ripon, Wis.*

Insect Pests on the Pacific Coast.—California seems to be overrun the present year with insect plagues. Not only are vast swarms of the genuine locust devastating the crops in Placer, Yuba, Navada, Amador, Napa, Sonoma, San Joaquin, Butte, Sacramento, El Dorado, Tehama and Mercer counties, but the wheat fields in Alamada, Napa, Sonoma and Solano counties are being very seriously injured by the Hessian fly, an insect which has hitherto been supposed not to occur on the Pacific coast. Professor Riley, the United States Entomologist, has received specimens, and they prove to be the true Hessian fly.

Entomological Notes.—In Siebold and Kölliker's Zeitschrift, issued May 8th, A. Sommer has an elaborate and well illustrated article on the anatomy and histology of the large common Poduran, *Macrotoma plumbea;* the descriptions, however, do not appear to be comparative. In the same number is an essay, with many illustrations, on the embryology of the mole cricket (Gryllotalpa), by A. Korotneff.——Another paper on the embryology of insects is one by Dr. Tichomirow, on the earlier stages of development of the silk worm *(Bombyx mori).* His observations deal with the process of segmentation, the first development of the heart, and on the occurrence of an inner skeleton in the head of the insect. He then discusses the chemical properties of the eggs. His paper was presented to the Physiological Society of Berlin, and is reported in *Nature* for April 30.——In the *Quarterly Journal of Microscopical Science*, for April, Sidney J. Hickson

discusses the eye and optic tract of insects, his observations corroborating the opinion of the majority of previous investigators, that the retinulæ are the true nerve-end cells, while Mr. F. S. Heathcote describes a peculiar sense organ in the Myriopoda, *Scutigera coleoptrata.*——A report on the anatomy of the cotton worm moth *(Aletia xylina)* by C. S. Minot and E. Burgess, extracted from the Fourth Report of the U. S. Entomological Commission, is illustrated by five plates. They describe a membrane on the metathorax of the moth, which they regard as probably homologous with the tympanal membrane or "ear" of the locust (Acrydium).——In Biologisches Centralblatt, Feb. 1, Dr. Dewitz describes the hooked hairs of Chrysopa larvæ, and a male sexual character in Catocala, which consists of a tuft of hairs which lies in a furrow on the middle femora, and which rises like a fan out of the furrow; this has been previously noticed in this country.——In an article on the development of *Sphærularia bombi*, in Zool. Anzeiger for May 11, Professor Leuckart maintains that this parasite of humble bees is nothing else than the female sexual apparatus of a nematoid worm, a kind of transplanted organ which meets with the proper conditions for existence in the body of a foreign host.

ZOOLOGY.

Indestructible Infusorial Life.—J. Hogg describes some further experiments he has made on this subject, supplementing those previously recorded on rotifers. Some Ciliata and Tardigrada have been included, and these have, although not to the same degree, exhibited a remarkable tenacity of life. The intervals of sleep and vigorous life have also been brought into strict accord with the durations of dry and wet periods of the year, so that the subjects of the experiments have been kept in a perfectly dry condition during the whole of the long drought which characterized the past summer.

Moreover, some older dried specimens were subjected to an artificial process of desiccation. They were kept for a time in a hot-air chamber, the heat in which was raised to 2000 F., and subsequently the miniature aquarium in which they were inclosed was plunged into a freezing mixture. Neither process killed them nor greatly diminished their vital powers, their revivification in both cases being somewhat delayed. Certain poisons known to exert a baneful influence over higher animals were added to the water supplied to the rotifers, but in no way did they produce discomfort; on the contrary, portions were taken into the stomach and partly digested. On the other hand, a drop of sewage water caused marked discomfort; they immediately retracted their rotating organs and sank to the bottom of the cell. These were, so far as could be ascertained, poisoned, and this was probable owing to the free sulphide of hydrogen evolved by the putrescent sewage. From

his observations the author is led to infer that rotifers will live and multiply on a very scanty supply of organic matter, provided only that the water is fairly well oxygenated. Attention is also called to the greatly diminished or no longer developed eye, due, no doubt, to the withdrawal of the stimulus of light, the rotifers being nearly always kept in the dark.—*Journal of the Microscopical Society, February, 1885.*

On the Morphology of the Carpus and Tarsus of Vertebrates.—As a result of embryological and literary studies I reach the following morphological table for the carpus and tarsus:

Mammalia.	Urodela (Menopoma, Cryptobranchus, Salamandrella, Ranodon, Axolotl).		Mammalia.
Carpus.	*Carpus.*	*Tarsus.*	*Tarsus.*
Scaphoideum	Radiale	Tibiale	Sesamoid articulating with naviculare and astragalus.[1]
Lunatum (intermed. Gegenbaur)	Centrale I[2]	Centrale I[3]	Distal part of astragalus.
Pyramidale (ulnare Gegenbaur)	Intermedium	Intermedium	Proximal part of astragalus (os trigonum Bardeleben).[4]
Pisciforme[5]	Ulnare	Fibulare	Calcaneus.
Centrale (Rosenberg)[6]	Centrale II	Centrale II	Naviculare.
Carpale of the rudimentary radial digit[7]	Carpale I	Tarsale I	Tarsale of the rudimentary tibial digit.[8]
Trapezium (carp. I Gegenb.)	Carpale II	Tarsale II	Cuneïforme I (tarsale I Gegenbaur).
Trapezoideum (carp. I Gegenb.)	Carpale III	Tarsale III	Cuneïforme II (tarsale II Gegenb.)
Magnum (carp. III Gegenb.)	Carpale IV	Tarsale IV	Cuneïforme III (tarsale III Gegenb.).
Unciforme (carp. IV and V Gegenb.)	Carpale V[9]	Tarsale V	Cuboideum (tarsale IV and V Gegenb.).
Metacarpale of rudimentary radial digit[10]	Metacarpale I	Metatarsale I	Metatarsale of the rudimentary tibial digit.[11]
Metacarpale I autorum	Metacarpale II	Metatarsale II.	Metatarsale I autorum.
Metacarpale II autorum	Metacarpale III	Metatarsale III	Metatarsale II "
Metacarpale III autorum	Metacarpale IV	Metatarsale IV	Metatarsale III "
Metacarpale IV autorum	Metacarpale V[12]	Metatarsale V	Metatarsale IV "
Metacarpale V autorum	Metacarpale VI[13]	Metatarsale VI[14]	Metatarsale V "

[1] Baur, G., On the morphology of the tarsus in the mammals. Amer. Naturalist, Jan., 1885, pp. 87–88.

Baur, G., Zur Morphologie des Tarsus der Säugethiere. Morphol. Jahrb., Bd. 10, Heft 3, 1884, pp. 458–461.

Albrecht, G., Sur les homodynamics qui existent entre la main et le pied des mammifères. Presse médicale belge, No. 42, du 19 octobre, 1884, pp. 10.

Bardeleben, R., Zur Entwicklung der Fusswurzel. Sitsungberichte Jenaische

Now the question is, where are to be found the relations to the reptiles, from which mammals have probably descended? I cannot look for the six-toed forms with paddles, Ichthyosaurus, Baptanodon (Sauranodon), Plesiosaurus, etc., for I consider those modified in the same way as the cetaceans. In the living lacertilians and chelonians we find the same condition in the carpus,

Gesellschaft für Medicin und Naturwissenschaften. Jahrg, 1885. 3. Sitzung vom 6. Februar, pp. 5.

Cope, E. D, Fifth contribution to the knowledge of the fauna of the Permian formation of Texas and the Indian Territory. Read before the American Philosophical Society, August 15, 1884. Palæont. Bull., No. 39, pp. 38–41, p. 46.

Marsh, O. C., Dinocerata, a monograph of an extinct order of gigantic mammals. U. S. Geol. Survey, Vol. x, 1884, p. 146.

[2] (*Ranodon sibiricus*, *Salamandrella keyserlingii*, *Salamandrella* (*Isodactylium*) *wosnessenskyi*.) Wiedersheim. R., Die ältesten Formen des Carpus und Tarsus der heutigen Amphibien. Morphol. Jahrb., Bd. II, 1876, Taf. XXIX.

[3] (Cryptobranchus, Menopoma, Ranodon, Salamandrella, Axolotl.) Hyrtl, J., *Cryptobranchus japonicus*, *Schediasma anatomicum*, Vindobonae, 1865, Tab. VI, VII.

Van der Hoeven, T., Note sur le carpe et le tarse du *Cryptobranchus japonicus*, Archives Néerlandaises, T. I, 1866, pp. 22, Fig. 2 (extr.).

Wiedersheim, R., l. c. and Nachtraegliche Bemerkungen zu seinem Aufsatze. Die ältesten Formen des Carpus und Tarsus der heutigen Amphibien. Morphol. Jahrb. Bd. III, 1877, pp. 154, Figs. 2, 3, 5.

[4] Bardeleben, R., Das os intermedium tarsi der Säugethiere. Zool. Anzeiger, VI Jahrg., No. 139, 21 Mai, 1883, p. 280.

Albrecht, P., Das os intermedium tarsi der Säugethiere. Zool. Anzeiger, VI Jahrg. No. 145, 6 Aug., 1883, pp. 419–420.

Bardeleben, R., Ueber das Intermedium tarsi. Jena. Sitzungsber., 1883, 8. Juni; and loc. cit. (I have not been so happy till now to find this bone in embryos of man, Insectivora, Rodentia, Carnivora.)

[5] Leboucq, H., Recherches sur la morph. du carpe chez les mammifères. Arch. de Biologie, Tome V, 1884.

Albrecht, P., Sur les homodynamies, etc.

[6] Rosenberg, E., Ueber die Entwicklung der Wirbelsäule und das Centrale carpi des Menschen. Morph. Jahrb., Bd. I, 1876.

Leboucq, H., Recherches sur la morphologie du carpe chez les mammifères. Arch. de Biologie, Tome V, 1884.

Baur, G., Ueber das Centrale carpi der Säugethiere. Morphol. Jahrb., Bd. 10, Heft 3, 1884.

Baur, G., On the centrale carpi of the mammals. AM. NAT., Feb., 1885.

[7] I found in a *Phalangista cookii* of 30^{mm}, received through the kindness of Professor Marsh, a rudimentary radial digit consisting of two pieces, a carpale and a metacarpale. The same condition I found in a skeleton of an adult *Chiromys madagasc.* The "sesamoid of the abductor pollicis" represents this element.

[8] I found in a *Didelphys virg.* of 15′ ^{mm}, for which I am indebted to Professor Osborn, a rudimentary tibial digit consisting of two pieces, a tarsale and a metatarsale. Conf. Bardeleben, K., Zur Entwicklung der Fusswurzel l. c. Rudiments of this digit are present in the Monotr., Rodentia, Carniv., Edent., Insectiv.

[9] This element probably existed in the Permian Urodela with five toes in the hand, and will probably be found in very young Urodela.

[10] Conf. 7.

[11] Conf. 8.

[12] Present in the Permian Urodela.

[13] Not yet found.

[14] I regard the piece in Cryptobranchus and Ranodon, hitherto considered a sixth tarsal bone, as the sixth metatarsal bone.

considering the "sesamoid" on the ulnar side, the pisiforme, *i. e.*, the ulnare; but it has not been possible hitherto to homologize directly the tarsus of the lacertilians and chelonians with that of the mammals. The Theromorpha of Professor Cope give the missing link. I believe with Professor Cope that "the subcylindric proximal part of the astragalus" is the intermedium (Professor Cope calls it erroneously centrale, but corrects this p. 46). In the distal part of the astragalus I see the first, and in the navicular bone the second central bone of Cryptobranchus, etc.

My further studies will be devoted to the morphogeny of the carpus and tarsus of the Sauropsidæ, and I shall be very much obliged to any one who may kindly aid me with material for examination.—*Dr. G. Baur, Yale Col. Mus., New Haven, Conn., April 12th, 1885*

A Black-footed Ferret from Texas.—I recently received from Mr. G. H. Ragsdale a specimen of the black-footed ferret, *Putorius nigripes*, captured near Gainesville, Cooke county, Texas. This is the second specimen of the species from Texas thus far recorded. The first was noted by Dr. Coues in this journal, in 1882 (Vol. xvi. p. 1009), and came from Abilene, Taylor county, near the centre of the State.—*F. W. True, Curator of Mammals, Smith. Institution.*

Zoological News.—*Vermes*—Robert Scharff (Quart. Jour. Micros. Soc.) gives the result of his investigations upon the skin and nervous system of *Priapulus caudatus* and *Halicryptus spinulosus.* The skin consists of a cuticula and hypodermis, with an extremely thin layer of connective tissue or cutis. The nervous system lies entirely in the ectoderm.

Polyzoa.—S. F. Harmer (Quart. Jour. Micros. Soc) contributes a paper upon the structure and development of Loxosoma. The investigations were carried on upon five species found at Naples. He concludes that "in order to understand correctly the phylogeny of the Polyzoa we must derive the group from a trochosphere-like organism, and that the Entoprocta have remained permanently at a grade hardly higher than that of this hypothetical ancestor. Loxosoma shows itself the most primitive genus by the fact that it forms no colonies, by the greater development of the brain in the larva, and by the invariable presence of a foot-gland in the buds, if not in the adult." The similarity between Loxosoma and a molluscan larva (Dentalium) is pointed out, and the author concludes that "of all organisms with whose ontogeny we are acquainted, the Mollusca come nearest to the Polyzoa," and that the Rotifera must be near the Polyzoa in many points; while the Brachiopoda are much less close.

Tunicata.—M. L. Roule has described three Phallusiadæ from the coasts of Provence in addition to the two recently described by him. One of these is intermediate between Molgula and

Eugyra; while the others belong to the genera Microcosmus and Cynthia.

Echinoderms.—The stalked crinoids collected by the *Challenger* and reported upon by Dr. P. H. Carpenter, raise the total of existing generic forms to six, with no less than thirty-two species. The bathymetrical range of the tribe is shown to extend from 100 fathoms to 2500. No less than 150 species of unstalked crinoids were collected by the same expedition. In the discussion of the morphological relations between the neocrinoids and the palæocrinoids, Dr. Carpenter is, upon certain points, at issue with Mr. Wachsmuth, the highest authority on the latter group. Of the species of Pentacrinus from West Indian seas, *P. asterias*, the *Isis asterias* of Linnæus, is the rarest, while *P. decorus* is far more plentiful than *P. mulleri*. Neither of these, nor *P. blakei*, have been met with elsewhere. Two species from the Western Pacific, one from the North Atlantic, on the European side, another from the tropical Atlantic, and a single mutilated type from the Japan sea, complete the known Pentacrini. There is, in fact, but little difference between this genus and Comatula, the chief distinction being that the basals of the pentacrinoid larva are retained in the adult Pentacrinus, whilst they disappear externally in Comatula. Living Comatulæ only perform their beautiful swimming movements in order to find a suitable base to which they can attach themselves by their dorsal cirri; while the stalked Pentacrini are not seldom detached by the fracture of their skins just below a nodal joint, and they then cling to any suitable attachment by means of the cirri of that joint, which bend downwards like the dorsal cirri of Comatula. The five-chambered organ at the base of the calyx is much smaller in Pentacrinus than in Comatula, but each node of the crinoidal axis presents a dilatation similar to the five in Comatula. In the Eastern Archipelago Pentacrinus is replaced by the allied Metacrinus, eleven species of which were dredged by the *Challenger*.

Crustacea.—W. B. Spencer (Quart. Jour. Micros. Soc.) describes the urinary organs of the Amphipoda, which consist of cæca opening into the posterior part of the intestine. They are present in Gammarus, Orchestia, Talitrus, and Caprella. Mr. Spencer concludes that these organs of strangely limited distribution amongst crustacea are excretionary and probably urinary, but present knowledge does not warrant us in regarding them as strictly homologous with the Malpighian tubes of Tracheata.

M. Y. Delage has discovered a nervous system in Peltogaster, which had before been believed to be without one. Eighteen months previously the same naturalist found a nervous system in Sacculina.

Mammals.—According to F. W. True, in a communication to *Science*, the milk of *Tursiops tursio* is of the color and consistency

of cream, without perceptible odor, and with the flavor of cocoanut milk. The fishermen state that this species, which is the one most common on the Atlantic coast, cannot remain under water more than four or five minutes. The color of the back, in some examples taken at Cape May Point, was a light plumbeous tint, but it appears that the depth of the color varies in different individuals, and deepens rapidly after life is extinct, especially if the specimens lie in the sun.

M. Paul Albrecht, in the *Pressé Medicale Belge*, 1884 (October), states that there are fourteen digits in the vertebrate foot. Seven of these are radial and tibial, one is axial, and six are ulnar and fibular.

M. Retterer, in a thesis presented to the Faculty of Sciences of Paris, describes the early stages of the limbs and feet in various mammalia. He shows that the primitive cartilages display the same numbers and character as the bones of the adults in a great many cases.

EMBRYOLOGY.[1]

On the Embryology of Limulus polyphemus.[2] III.—The stage under examination is that represented on Figs. 12 and 13, 14 and 15 (Plates III and IV) of my essay on the development of Limulus (Memoirs Boston Society Natural History, 1872). At this stage the oval blastodermic disc, with the six pairs of the cephalic appendages, is distinctly formed; the mouth is seen in a position in front of the first pair of appendages, and from it the primitive streak passes back to the posterior margin of the blastodermic disc or "ventral plate." The abdomen is separated from the head by a curved groove, as seen in Fig. 12 of my memoir.

The period examined is an interesting one, as while the cephalic appendages were well developed the abdominal appendages were not as yet indicated, nor the post-oral nervous ganglia.

The first point, which at once excited my attention, was the nature of the embryonic membrane, which I had previously regarded as the homologue of the amnion, and afterwards as the serous membrane of insects, but which Mr. J. S. Kingsley[3] has found to be secreted from the blastoderm. A thin section (Plate XXIV, Figs. 1 and 5) shows that the membrane is very thick, structureless, the cellular appearance being confined to the external surface. This membrane is evidently secreted by the blastoderm; the irregular cell-like markings (see my second memoir, 1880, Pl. III, Figs. 14, 14*a*, 14*c*, 14*d*) are, so to speak, casts of the blastoderm cells, which with the marks of even their nuclei are impressed upon the membrane during the early stage in its forma-

[1] Edited by John A. Ryder, Smithsonian Institution, Washington, D. C.

[2] Read before the American Philosophical Society, January 16, 1885.

[3] The Development of Limulus, *Science Record*, II, pp. 249–251, Sept., 1884.

tion; after a while new matter is added to the interior which is structureless, so that the cellular appearance is only superficial. In my comparison of this membrane with the serous membrane, I certainly exaggerated its resemblance to the *serosa* of insects, as the latter is a much more delicate membrane, and with a characteristic appearance in Crustacea, the scorpion, myriopods and hexapods. The membrane in question appears to have its homologue, however, in the embryonic membrane of Apus, which we have described in a foot-note on p. 161 of our first memoir. It thus appears that this supposed point of resemblance in Limulus to the Tracheata is removed.

A longitudinal section of the embryo of Limulus is represented by Fig. 2. The section passes through the blastodermic disc (ventral plate) and the indications of the appendages, on one side of the median line of the body. The epiblast entirely surrounds the yolk, forming a thin layer with nuclei, the cell walls not being distinct, while the nucleolus consists of a number of granules. The nuclei are two deep only on the cephalic portion of the embryo. The blastodermic disc does not extend quite half way around the egg. The six pairs of appendages are well developed, increasing in size from the first to the last pair. The mesoblast is now well developed; the nuclei well marked, but the cellular walls more or less effaced. The mesoblastic arthromeres are now well indicated. The somatic cavities are well marked in each appendage; the somatopleure is from one to three cells deep; the splanchnopleure is formed usually of two layers of cells, and is more or less continuous at the ends of the somatic cavities with the somatopleure. The relations of these divisions of the mesoblast, which are destined to form the muscles of the limbs and the ventral aspects of the body, are represented in Fig. 3.

The mesoderm, as seen in Fig. 3, is now differentiated into three sublayers: 1, the somatopleure; 2, the splanchnopleure, and 3, a sublayer from which probably arises, in part at least, the connective tissue so remarkably developed in the head of Limulus; in its thickest portion at this stage this innermost layer consists of about eight series of cells, which are more loosely arranged than in the sublayers next to the epiblast.

The yolk granules are minute, the largest granules not more than twice as large as the nuclei of the mesoderm. The hypoblast cells are by far the largest cells in the embryo, and at once attract attention by reason of their size and their deep color when stained; the nucleus and nucleolus are well marked. At this stage no hypoblast cells could be detected in the yolk, nor any protoplasmic network connecting them. Those present formed a dorsal row ranged next to the thin epiblast over about one-quarter of the periphery of the ovum. In an earlier stage, however, the yolk granules are contained in distinct polygonal cells, forming a network extending through the yolk.

The abdomen has not yet undergone segmentation; the incipient steps are represented in Fig. 2, where there appear to be arising five mesoblastic segments (1, 2, 3, 4, 5). Between the first and second mesoblastic mass is a narrow cavity which sends a branch forward to the base of the abdomen, and a second obliquely downward and inward; at 2 and 3 in Fig. 2 there are narrow cavities or splits (somatic cavities ?) which communicate with a longitudinal internal opening, which extends in a direction parallel to the under (now outer) surface of the abdomen. In this respect the embryo of Limulus is very different from that of the scorpion and spiders (see especially Balfour's Figs. 5, 6, Pl. XIX, and Fig. 15, Pl. XX), where the abdominal segments, with their appendages and somatic cavities are formed contemporaneously with those of the cephalothorax. The innermost mesodermic cells are now arranged in long cords, destined to form the ventral adductor muscles of the abdomen.

The mode of formation of the head and its shape at this time presents important differences from that of tracheate embryos. The procephalic lobes are not developed; the preoral portions of the head, *i. e.*, that part in front of the first pair of limbs is very small, short and narrow, merely forming the end of the oval blastodermic disc, seen in my earlier published figures. The structure of the preoral portion of the head (*procephalum* as we may term it), is seen in longitudinal section in Fig. 3, *pc*, to apparently consist merely of an extension of the postoral part of the head; with apparently one or two splits in the mesoderm (ms^1, ms^2), the nature of which I do not understand; undoubtedly farther sections and comparisons will throw light upon it.

The first nervous ganglion is seen at Fig. 5 to result (as also first shown by Kingsley) in an ingrowth of the epiblast (*inv. c*); carrying into the interior a mass of epiblastic nuclei, which envelop the myeloid substance (*my*), which, as in older embryos, remains unstained by the carmine.

The mesoblastic nuclei stop at a large cell (*c*), beyond which are long incipient loose muscle-cells with a few scattered nuclei.

The procephalum terminates abruptly, forming, as seen in our earlier figures already referred to, the end of the blastodermic disc.

The absence of the procephalic lobes in the embryo Limulus of this stage seems to us to be a very significant fact, and to point to the early divergence of the Palæocarida from the stem leading up to the Tracheata, and especially the Arachnida. Metschnikoff's researches on Scorpio, with those of Claparède, and of Balfour on the spiders, and those of Sograff on the myriopods, show that this is a fundamental and early attained feature in these types. Their absence in Limulus shows how little its embryo has in common with tracheate embryos. At the same time the general mode of formation of the blastodermic disc (ventral plate) of

Limulus is much like that of the spider, as seen in the mode of origin of the mesoblastic segments and the probable origin of the hypoblastic cells. There is a superficial resemblance between the embryo of Limulus and of the spider, as may be seen by a comparison of our Fig. 2 and Balfour's Fig. 15. Without much doubt the Tracheata and Palæocarida, as well as Crustacea Neocarida, branched off from a common ancestor, but the more important morphological points show that the terrestrial, air-breathing tracheates were a much later branch of the arthropod tree than the marine branchiate Palæocarida and genuine Crustacea. Probably the Palæocarida (Limulus and other Merostomata, and Trilobita) were the earliest arthropods to appear; after them arose the Crustacea, perhaps at nearly the same time the Arachnida, and finally the Myriopoda and the winged insects. Without much doubt the earliest branchiate forms were our Protocyclus,[1] the ancestor of the Palæocarida; and a protonauplius form, the forerunner of the Crustacea; these were marine, perhaps branchiate organisms, with a few pairs of simple oar-like swimming appendages either around or just behind the mouth, and which were free-swimming or creeping forms; the Protocyclus was, perhaps, a solid oval creeping animal living at the bottom on mud or sand. The branchiæ probably became first developed on the limbs of the free-swimming Protonauplii, as they needed, owing to their great rapidity of movement, the means of rapid aëration of the blood; while in the heavily molded less oxygen-consuming Protocyclus, the evolution of gills was somewhat postponed. The steps from Protocyclus to Agnostus was not a very long one. The oldest arthropods, notwithstanding the recent discovery of a Silurian scorpion, were trilobites.

The following conclusions are drawn from a study of the stage of Limulus here figured.

The fact that the embryo Limulus had at first no abdominal appendages (uropoda), whereas there are temporary abdominal appendages in the tracheates, shows that Limulus in this important respect has little in common with the Arachnida, Myriopoda or Hexapoda. On the other hand in the embryo Crustacea the cephalic limbs are first indicated; the nauplian limbs as well as the zoëan appendages being cephalic; the uropods not appearing until after the Crustacea leave the egg.

These facts indicate that Limulus probably descended from a type in which there were cephalic appendages only, and no abdominal appendages. The absence of a serous membrane, of an amnion, and of procephalic lobes, of temporary embryonic abdominal appendages (at the stage above described); also of protozonites (seen in the early embryo of the scorpion and spider) tend to prove that the embryo of Limulus has little in common with that of Tracheata.

[1] See Development of Limulus, 1872, p.

On the other hand the earlier stages in the embryology of Limulus resemble those of Crustacea in the absence of the procephalic lobes; in the primitive development of cephalic appendages alone; the comparatively early appearance of the branchiæ of Limulus in the stage succeeding that figured in this essay, shows that the Limulus probably never had any genetic connection with a tracheate arthropod.

On the other hand, the tracheate features of mesoblastic somites are also seen in the worms, in Peripatus and in Annelida.

It appears that the embryology of Limulus is scarcely more like that of tracheates than Crustacea; it is a very primitive type standing nearer the branchiate arthropods than the tracheate, but on the whole should be regarded as a generalized or a composite form, which with its fossil allies, the Eurypterida and Trilobita, form a class by themselves with a superficial resemblance to the Arachnida.

It seems to us that the above-mentioned characters, which separate the early embryo of Limulus from the tracheates, are as important, if not much more so, than those of the absence at first of an archenteric cavity or differences in the mode of origin of the mesoblast, noted by Mr. Kingsley in his brief paper on the development of Limulus. In these general, primitive embryonic characters Limulus appears to be as nearly allied to the annelids as to the tracheates; and too much dependence should not, it seems to us, be placed upon them in seeking to establish the true relations of the Palæocarida among the arthropods. In the higher worms the two longitudinal mesoblastic bands split into somatic and splanchnic layers (Kowalevsky). In Mysis Metschnikoff states that the mesoblast becomes broken up into distinct somites (Balfour's Embryology, I, 436). If so, then this character is not one of much importance to separate Limulus from the Crustacea. The ultimate origin of Limulus from the same stock as that which gave rise to the modern annelids seems not improbable.

EXPLANATION OF PLATE XXIV.

FIG. 1.—Blastodermic cuticle (*bl. cut*) lying upon the epiblast (*ep*). The nuclei scattered through the latter; the nucleolus in these as well as the mesoblast cells, consisting of a number of granules. $\times \frac{1}{5}$ A.

FIG. 2.—Longitudinal section through an embryo before the appearance of the abdominal appendages, but after the rupture of the chorion; the section passes through the six cephalic appendages (I–VI), showing the somatic cavities (*ms*), the splanchnopleure (*sp*), and somatopleure (*so*); 1–5, the indications of the five primitive uromeres; *hy*, hypo- or ectoblast. $\times \frac{1}{5}$ A.

FIG. 2*a*.—Showing the relations of hypblastic cells (*hy*) to the epiblast (*ep*) in the dorsal region of the embryo.

FIG 3.—Longitudinal section of the head and the first three appendages; ms^1, ms^2, first and second somatic cavities in the preoral region of the head. This figure also shows the relations of the splanchnopleure and somatopleure to the epiblast. *c*, large distinct cell in preoral region. $\times \frac{1}{5}$ A.

FIG. 4.—Transverse section through the head, including the appendages. $\times \frac{1}{5}$ A.

EMBRYOLOGY OF LIMULUS

FIG. 5.—Transverse section through the head, showing the invagination and thickening of the epiblast to form the brain; *my*, myeloid substance of the ganglion. $\times \frac{1}{5}$ A.

All the longitudinal sections are from the same egg, and the transverse sections from another. The figures were all drawn by the author with the camera.

—*A. S. Packard.*

PHYSIOLOGY.[1]

SCIENCE VS. THE "ZOÖPHILIST."—The believers in physiological experiment upon animals as a means for increasing our knowledge of the body will all heartily indorse Professor Martin in his vigorous "castigation" of the truth-distorting and fanatic *Zoöphilist*, an English sheet whose ostensible object is the prevention of cruelty toward animals. People who are opposed to what is popularly known as "vivisection," may be divided into two classes, the reasonable and the unreasonable. It is the duty of physiologists to maintain the respect of the former class by the presentation of the abundant arguments which defend the use of the lower animals, under proper conditions, for scientific purposes. The latter class could probably never be completely silenced except by a course of unresponsive contempt, but for all that one must occasionally be pleased to see a fool get his just deserts.

CONDITIONS MODIFYING THE DIASTATIC ACTION OF SALIVA.—Messrs. Chittenden and Smith have extended the valuable researches of the former upon the diastatic action of saliva. The following are their conclusions:

"1. The diastatic action of saliva can be taken as a definite measure of the amount of ferment present only when the dilution of the saliva in the digestive mixture is as 1 : 50 or 100. The limit of dilution at which decisive diastatic action will manifest itself with formation of reducing bodies is 1 : 2000–3000, under the conditions previously given. 2. The diastatic action of neutralized saliva is greater than that of normally alkaline saliva. The difference is particularly noticeable where the dilution is as 1 : 50 or 100, and is apparently out of all proportion to the amount of alkalinity. 3. Sodium carbonate retards the diastatic action of saliva in proportion to the amount of alkaline carbonate present. The percentage of alkaline carbonate, however, which hinders diastatic action can be designated only for definite mixtures and not in a general sense, being dependent on the dilution of the saliva and the consequent change in percentage of proteid matter. 4. The destructive action of sodium carbonate is materially modified by the dilution of the saliva, becoming greater the more the fluid is diluted. This result is due not to simple dilution but doubtless to the diminished amount of proteids. 5. Neutral peptone has a direct stimulating effect on the diastatic action

[1]This department is edited by Professor HENRY SEWALL, of Ann Arbor, Mich.

of neutral saliva. 6. The presence of small percentages of neutral peptone tends to raise the diastatic action of normally alkaline saliva to a point even beyond the action of the neutralized fluid; due in part doubtless to a loose combination of the alkali with the proteid matter, and also to a direct stimulation of the ferment. Likewise peptone tends to diminish in a similar manner the retarding action of the various percentages of sodium carbonate. To accomplish this, however, the amount of peptone must be proportionate to the percentage of alkaline carbonate. 7. Peptone tends to prevent the destructive action of dilute sodium carbonate on salivary ptyalin, thus giving proof of the probable formation of an alkaline-proteid body. 8. Saliva with its proteid matter saturated with acid appears to have a greater diastatic action than when simply neutralized; except when the acid proteids thus formed are above a certain percentage. Small percentages of peptone saturated with acid similarly increase the diastatic action of neutralized saliva up to a certain point. Increasing the percentage of acid-proteids finally causes a diminution of diastatic activity. 9. The retarding influence of acid-proteids is out of all proportion to their power of destruction. Large percentages, however, of acid-proteids may cause almost complete destruction of the ferment. 10. The most favorable condition for the diastatic action of ptyalin, under most circumstances, appears to be a neutral condition of the fluid together with the presence of more or less proteid matter. The addition of very small amounts of hydrochloric acid, however, to *dilute* solutions of saliva, giving thereby a *small percentage* of acid-proteids, appears to still further increase diastatic action. Under *such conditions* a minute trace of free acid appears to still further increase the action. 11. 0.003 per cent free hydrochloric acid almost completely stops the amylolytic action of ptyalin. The larger the amount of the saturated proteids the more pronounced becomes the retarding action of free acids. 12. The retarding action of the smaller percentages of free acid are not due wholly to destruction of the ferment. Pronounced destruction takes place with 0.005–0.010 per cent free hydrochloric acid. 13. Proteid matter, in influencing the diastatic action of salivary ptyalin, acts not only by combining with acids and alkalies, but apparently also by direct stimulation of the ferment."—*Trans. Conn. Acad., March, 1885.*

Physiology of the Sympathetic Nerves.—The generalization of Dr. Gaskell "On the relationship between the structure and the function of the nerves which innervate the visceral and vascular systems" are of the highest interest and importance. Dr. Gaskell calls attention to the fact that involuntary muscles, visceral and vascular as well as cardiac muscle, are supplied by two kinds of nerve fibers which are histologically distinct, the medullated

or white and the non-medullated or gray nerve fibers. Contraction of involuntary muscle is brought about exclusively by impulses proceeding along the non-medullated nerves, while relaxation or inhibition of muscular contraction is as invariably produced by impulses conducted by the medullated nerves. All nerves in their course from the spinal cord to the sympathetic ganglia are of the medullated variety, but on leaving the sympathetic ganglia they are separable into two groups of medullated and non-medullated fibers; the medullated sympathetic fibers are, however, easily distinguished from those of ordinary striated muscle by their smaller diameter.

Dr. Gaskell writes: "In previous communications I have shown that the heart of various cold blooded animals, *e. g.*, frog, tortoise, crocodile, is innervated by nerves coming from two distinct sources in the same way as the heart of the warm-blooded animal; and I am now enabled to make the further communication that in the dog, cat, rabbit, tortoise and crocodile these two sets of nerve fibers are structurally differentiated from each other in precisely the same manner. The vagus fibers from their origin up to their entrance into the heart are medullated, the sympathetic fibers in the whole of their course from the basal ganglia of the sympathetic along the annulus of Vieussens to the heart are non-medullated. * * * Every involuntary muscle is innervated by two nerves which are histologically and physiologically distinct; the one gray, non-medullated, causing contraction of the muscle; the other white, fine, medullated, causing relaxation of the muscle."—*Jl. of Physiology, Vol. vi, p. iv.*

ANTHROPOLOGY.[1]

THE AMERICAN ANTIQUARIAN.—This valued exchange has now become a bi-monthly. The anthropological papers of No. 5, Vol. VI, are:

Hindoo mythology. By F. G. Fleay.
Dates in the ancient history of S. America. By M. Castaing.
The hill tribes of India. John Avery.
Emblematic mounds. By S. D. Peet.

The paper of Mr. Avery is of great value, not only in naming and describing tribes, but in the explanation of certain customs. The article by the editor relates to the attitudes of the animals in the emblematic mounds, and supports the view that the constructors had in mind the various poses of the animals, which are familiar to hunters.

METALLURGY AMONG SAVAGES.—Dr. Richard Andree has just published in Leipzig a most interesting monograph with the following title: "Die Metalle bei den Naturvölkern mit berücksichtigung prähistorischer verhältnisse, mit 57 abbildungen im text.

[1] Edited by Professor OTIS T. MASON, National Museum, Washington, D. C.

Leipzig, Veit u. Comp., 1884," pp. 166. The topics treated are as follows:

Iron and copper among the Negro races.
Iron and copper in hither India.
The Gypsies as metal workers.
Metallurgy among the Malays, farther India, China, Japan, Northern Asia.
Knowledge of iron among the American Indians.
Copper in North America.
Copper and bronze in Mexico.
Metals used by the Chinchas.
Copper and bronze in Peru.
The spread of iron in the South Sea islands.

THE FRANKFURT CRANIOMETRIC AGREEMENT.—A full statement of this agreement has been published in the NATURALIST, and its importance is so great that we draw attention to Professor Garson's objections to it. In the first place, since those devoting themselves to any branch of science belong to one brotherhood, the introduction of the word German is unfortunate. In drawing up any code of craniometric measurements the researches of Broca must be the basis. Professor Garson advocates the condylo-alveolar plane. The audito-orbital plane is in some instances directed more or less obliquely downward; it is more difficult to place the skull in the latter plane; the apparatus of suspension is complicated and in the way of important measuring. Again, the horizontal measures are not important, the form of the skull is quite as fully indicated by measurements from fixed points by the sliding callipers. The following Frankfurt measurements are accepted, the numbers are those of the agreement:

2. Maximum length.
4. Maximum breadth.
5. Maximum frontal breadth.
7. Height (basio-bregmatic).
10. Basio-nasal length.
12. Length } of foramen magnum.
13. Breadth } of foramen magnum.
14. Horizontal circumference.
15. Fronto-occipital arc.
17*a*. Bi-jugal breadth.
18. Bi-zygomatic breadth.
18*a*. Inter-orbital breadth.
21. Height of nose.
22. Breadth of nose.
23. Orbital breadth.
25. Orbital height.
30. Basio-alveolar length.

The following measurements are rejected:

1. Horizontal length.
6. Total height.
8. Ear height.
9. Auxiliary ear-height.
11. Basilar length.
13*a*. Bi-mastoid width.
13*b*. Breadth of base of skull.
16. Transverse vertical arc.
17*b*. Infra-jugal facial breadth.
24. Maximum horizontal orbital breadth.
26. Vertical height of orbits.
27. Palatal length.
28. Palatal breadth.
29. Posterior palatine breadth.
31. Profile angle.

REVUE D'ANTHROPOLOGIE.—Numbers I and II for 1882 contain the following papers:

Description élémentaire des circonvolutions cérébrales de l'Homme, d'après le cerveau schematique. By Paul Broca and S. Pozzi.

Le Transformisme. Cours d'Anthropologie Zoologique de l'Ecole d'Anthropologie. By Mathias Duval.

Etudes sur les Populations primitives. Les Cafres et plus specialement les Zoulous. By M. Elie Reclus.

Le Poids du Cervelet, du Bulbe, de la Protuberance et des Hémispheres, d'après les registres de Broca. By Dr. Philippe Rey.

Etudes sur les Populations Primitives, etc. (fin.)

De l'Angle Zyphoïdien. By Adrien Charpy.

Etude sur les Kalmoucks (suite). By J. Denilar.

ETHNOGRAPHY OF GUATEMALA.—Dr. Otto Stoll, a resident physician in Guatemala, has undertaken to supplement the work of Brasseur and of Berendt on the comparative linguistics of the Central American States. There are eighteen languages now spoken in Guatemala, fourteen of them belonging to the Maya Qu'iché, viz., Maya, Mopan, Chol, Qu'ekchi, Pokonchi, Uspanteca, Ixil, Aquacateca, Mame, Qu'iché, Cakchiquel, Tzu'tuzil, Pokomam, Chorti. The Sinca, Pupuluca, Pipil and Carib represent other stocks. Dr. Stoll takes up his work in a very systematic manner, stock by stock, giving in each the tribes examined together with the literature, synonymy, chirography, history and vocabulary. Thus:

I. Aztek stock. The Pipils (Escuintla and Cuajiniquailapa).
Synonymy: Pipil (authors); Mejicano and Nahuate (Juarros); Nahual of the Balsam coast and of Izalco (Squier); Mexicanic or language of the Tlaskaltekas (Scherzer).

II. Mije stock. The Pupulucas (Cognaco, extreme south-east).
Synonymy: Pupuluca (Juarros; Populuca (Palacio); Popoluca (Berendt MSS.).
Papuluka (Brasseur) is the name of a Cakchiquel village, and Scherzus Pupuluka Katschike is pure Cakchiquel.

III. Carib stock. The Caribs (Gulf of Honduras).

IV. The Maya-Qu'iché stock. 250 words in sixteen languages given.

Dr. Stoll divides the Maya into four groups:

A. Tzendal.
B. Pokonchí.
C. Qu'iché.
D. Mame.

A. Tzendal group. 1. Chontals of Tabasco.
Synonymy: Do not confound them with the "Chontales" of Nicaragua, who are entirely different.

2. Tzentales (Ocosingo).
Synonymy: Celdal (Cepeda).

3. Tzotziles (San Christobal de Chiapas).
Synonymy: Cinacanteca (Cepeda); Zotzlem (Brasseur) or Zotzil; Quelenes (Spanish historians).

4. Chañabal (Comitan, near north of Guatemala).

5. Choles (across Guatemala from Salinas r. to Motagua r., see p. 90).

Synonymy: Putum (Berendt); Cholti (Moran); Colchi (Palacio); Ecolchi (Alonzo de Escobar).

6. Mopanes (north of Chols in Guatemala).

B. Pochonchi group. 1. Qu'ekchis (east, west and north of Coban).

Synonymy: Cæchi (Palacio); Caichi (Juarros); Egkchi (Habel); Cakchi (Charencey); Vater confounds Cacchi with Qu'iché.

2. Pokonchis (around Tactic).

Synonymy: Spelled Poconchi, Pocomchi and Pokomchi. The Poconchi of Gage and Scherzer is Pokomam.

3. Pokomams (Guatemala to Jalapa and eastward).

Synonymy: Poconchi (Gage and Scherzer); Pokome (Charencey).

4. Chortis (Zacapa and Chequemula and eastward).

Synonymy: Lenguaapay (Palacio); Chol (Jimenez, by Brasseur).

C. Qu'iché group. 1. Qu'ichés (Cunen and Rabinal, south-west to Pacific).

Synonymy: Lengua Utatleca (authors) also Kiché.

2. Uspantaks (S. Miguel Uspantan).

3. Cakchiquels (Tecpam to Sta Lucia and to Pacific).

Synonymy: Lengua Achi (Fuentes, Palacio); Cuauhtemalteco ? (Palacio); Kacchikil (Vater); Chacciquel (Th. Gage); Pupuluka Katschikel (Scherzer); also Cakchiquelchi.

4. Tz'utujiles (around Atitlan).

Synonymy: Sotojil (Fuentes); also Zutuhil, Tzutohil.

D. Mame group. 1. Ixiles (Cotzal and vicinity).

2. Mames (all Southwestern Guatemala).

Synonymy: Zakloh pakap (Reynoso); Mem (authors).

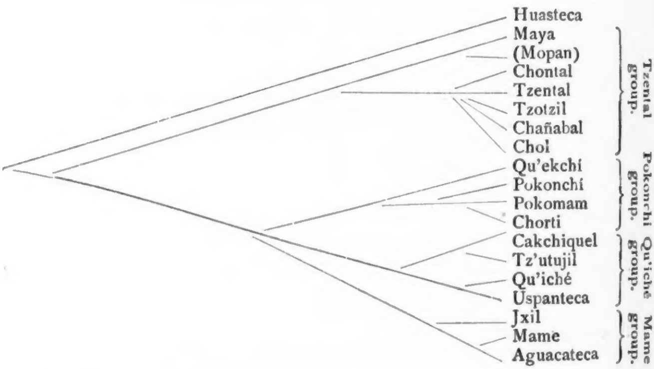
3. Aguatecas (Huehuetenango).

The Sinca language (Southeast Guatemala).

Synonymy: Sinca (Juarros); Xinca (Berendt MSS.); Xorti (Gavarrete's chart).

The Alagüilac language (S. Cristobal) little known.

Scheme of the Maya Languages.



While upon the Maya it is well to note that H. de Charencey continues his treatise on conjugation in the Maya-Qu'iché lan-

guages, in Le Muséon, Vol. III, 517–651; and Daniel G. Brinton publishes in the Proc. Am. Phil. Soc., No. 115, pp. 345–412, a grammar of the Cakchiquel language of Guatemala.

MICROSCOPY.[1]

MAYER'S CARBOLIC ACID SHELLAC.—Finding that clove oil and creosote produce fine granulations when used in the ordinary shellac method, Dr. Paul Mayer has adopted a new method of dissolving the shellac, by which an excellent fixative is obtained that never shows any traces of granulation. The fixative is applied by a fine brush to the *cold* slide.

Mayer prepares the solution in the following manner:

1. Dissolve one part of bleached shellac in five parts of absolute alcohol.

2. Filter the solution and evaporate the alcohol on a water-bath. A yellowish residue quite stiff when cold is thus obtained. If any cloudiness arises during evaporation, the solution must be filtered again.

3. Dissolve the shellac residue in pure carbolic acid on a water-bath. A concentrated solution of carbolic acid is obtained by exposing the crystals to the air until they dissolve, or by adding a small amount of water (about five per cent).

The quantity of acid should be sufficient to give a thickish liquid when cold.

This fixative is painted on to the cold slide with a brush, at the time of using. The sections are then placed, and the slide left in the oven of a water-bath for some minutes (10–15 minutes I find sufficient). The carbolic acid is thus evaporated, leaving a perfectly transparent stratum of shellac on the slide. The sections are next freed from paraffine in the ordinary way and mounted in balsam.

This method is considered to be the best and simplest for fixing *stained* sections.

The shellac can be dissolved directly in carbolic acid, but then the fluid must stand a long time in order to become clear, as it cannot be filtered. For this reason it is preferable to dissolve first in alcohol.

NOTE.—According to a note just received, Mayer now prepares the shellac as follows:

The shellac is pulverized and heated with crystals of colorless carbolic acid until it dissolves. In filtering the funnel should be heated over a flame. It will filter slowly but quite well. If it is too thick crystals of carbolic acid may be added until the desired consistency is reached.

AN ETHER FREEZING APPARATUS.[2]—A very simple and convenient little freezing apparatus, which can be used with almost any microtome, has recently been described by W. Emil Bœcker.

[1] Edited by Dr. C. O. WHITMAN, Mus. Comp. Zool., Cambridge, Mass.
[2] Zeitschr. f. Instrumentenkunde. Apr., 1884, pp. 126–127.

Following the principle of the Lewes and the Ray[1] instruments, the ether spray is thrown on the under side of the object-plate instead of on the object itself.

The apparatus consists of a short cylinder (Fig. 1 *A*), closed by the plate, *P*, on which the object is placed for freezing. A metallic tube (*a*) drawn to a fine point penetrates the base of the cylinder, and another (*b*) its side. The vertical tube (*a*) is connected by rubber tubing with a small bellows, while the horizontal tube (*b*) is similarly connected with a glass tube which passes through the stopper of a bottle containing ether, reaching nearly to the bottom. When the bellows is set in motion the current of

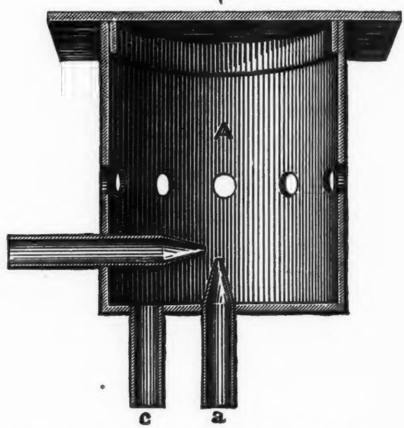


FIG. 1.—Freezing cylinder seen in section.

air throws the ether spray against the plate, *P*, and the rapid evaporation thus produced soon lowers the temperature sufficiently to freeze the object. The ether vapor and the air escape through a series of holes in the side of the cylinder. A third tube (*c*) connects with a second glass tube that extends barely through the stopper of the bottle of ether, and thus provides for the admission of air into the bottle and for the escape of the excess of condensed ether.

The cylinder is small enough to be received by the holder of the microtome. It is to be obtained from W. Emil Boecker, in Wetzlar, Germany, at sixteen and a half marks ($4.25).

The Roy microtome, referred to above, is made by Schaure, Pathologische Institut, Liebig-Strasse, Leipzig.

A NEW FREEZING MICROTOME.—Dr. F. O. Jacobs, of Newark, O., has devised the freezing microtome shown in Figs. 1 and 2.

[1] Arch. f. mikr. Anat., XIX, pp. 137–143, Pl. VI, 1880.

It consists of a copper rod, *A*, two inches or more in diameter and six inches high, inclosed by an inner zinc (*b*) and an outer brass tank (*c*). Above is the table, *D*, working on a fine screw (*d*). Through the center of the table passes a narrower portion of the copper rod, the piston (*p*).

When the inner tank is filled with a mixture of salt, ice and water, the temperature of the copper rod is so reduced as to

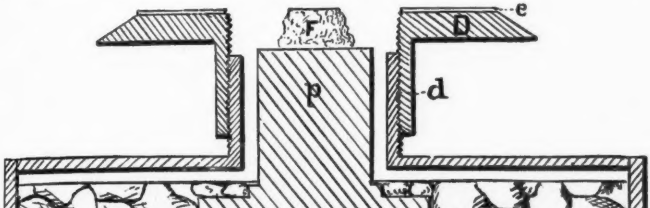


FIG. 1.—Freezing microtome.

freeze any object (*F*) placed on its upper end. The size of the rod is such that its temperature will remain very steady for from four to six hours without any further care on the part of the operator.

By this arrangement, the advantages of which will be readily seen, objects can be easily frozen, and without any slop or "muss."

The imbedding medium is composed of:

Gum arabic	5 parts.
Gum tragacanth	1 "
Gelatine	1 "

The mixture is dissolved in enough warm water to give it the

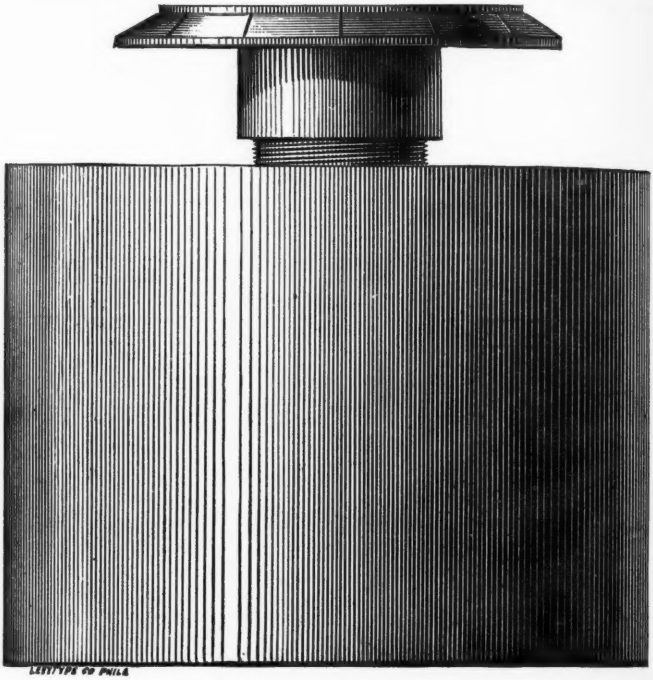


FIG. 2.—Section of the same.

consistency of thin jelly when cold. A little glycerine (1 : 6) is added to the water.

——:o:——

SCIENTIFIC NEWS.

— Under the title "Elephant pipes in the museum of the Academy of Natural Science, Davenport, Iowa," Mr. Charles E. Putnam enters a vigorous and well written protest against the criticisms and insinuations which have been made against the character of the discoverer and the authenticity of the elephant pipes in the museum of the Davenport Academy. The article is racy reading, and incidentally gives strong arguments against the desire for centralization in science shown in certain quarters. It will be found impossible to concentrate all science in any one clique or city. Our local societies and scattered observers need not feel that their efforts are not as valuable in their way as the labors of government officials and closet or office naturalists.

— The Bulletin of the Natural History Society of New Brunswick, No. IV, contains the following papers: A preliminary list of the plants of New Brunswick, by James Fowler; The surface geology of Fredericton, N. B., by W. T. L. Reed; The invertebrates of Passamaquoddy bay, by W. F. Ganong; the more valuable being Mr. G. F. Matthews' on recent discoveries in the Saint John group, with a letter from Professor A. Hyatt.

— Among recent works on fishes which have appeared in Europe are the second and third parts of Professor Lilljeborg's "Swedish and Norwegian Fishes," prepared in the same thorough manner as his late work on Scandinavian mammals. From William Sörensen we have received an important physiological and anatomical treatise on the organs of hearing in fishes, a book of 245 pages with four excellent plates. The Dipnoi have been studied anatomically and physiologically by Howard Ayres, Ph.D., whose memoir appears in the Jena Zeitschrift, and is illustrated by numerous figures.

— The annual meeting of the American Society of Microscopists will be held in Cleveland, Ohio, Aug. 18–21, 1885, and while of especial interest to microscopists is of interest to students in every departmont of science. The working session, in which the most approved and original methods of microscopical investigation will be practically demonstrated by leading experts, will be of value to all working naturalists and students.

— The lectures on natural history now being delivered to the school teachers of the city of New York, by Professor A. S. Bickmore, have, as we personally know, proved a decided success, both in point of numbers and interest manifested both in the lectures and exhibitions of specimens to the audience in the work-rooms of the American museum at Central park.

— The next meeting of the American Association for the Advancement of Science will be held at Ann Arbor, Mich., beginning Aug. 26, 1885. The Entomological Club will meet at that place Aug. 25th.

— The British Association will meet at Aberdeen, Sept. 9th. The president is Sir J. W. Dawson; the president elect, Right Hon. Sir Lyon Playfair, K.C.B.

— The French Association for the Advancement of Science will meet this year at Grenoble, on Aug. 13, under the presidency of Professor Verneuil.

— *Errata.*—Page 608, line 14, for he *read* we.
" 608, " 33, " Fregana *read* Freyana.
" 609, " 17, " sub-lined *read* six-lined.

PROCEEDINGS OF SCIENTIFIC SOCIETIES.

BIOLOGICAL SOCIETY OF WASHINGTON, May 16.—Communications: Mr. Frederick W. True, Exhibition of a specimen of the Guereza monkey, *Colobus guereza;* Dr. Tarleton H. Bean, Note on a new fish from Florida, allied to Murænoides; Mr. J. L. Wortman, On the reduction of the molar teeth of the Carnivora; Professor Otis T. Mason, On post-mortem trepanning; Mr. Lester F. Ward, Some Cretaceous fossil plants from the Laramie group.

May 30.—Mr. Lester F. Ward, Recent flowering of the Ginkgo tree in Washington, with remarks on the phylogeny of the genus; Dr. H. G. Beyer, U.S.N., The physiological effects of cocaine; Dr. C. V. Riley, Notes on the periodical Cicada; Col. Marshall McDonald, A theory to explain the phenomenal abundance of migratory fishes in certain seasons; Dr. Thomas Taylor, How to distinguish between animal and vegetable fats.

NEW YORK ACADEMY OF SCIENCES, May 11.—The following paper was presented: The geology of the Bermuda islands, by Mr. James F. Kemp, E.M.

May 18.—The last public lecture of the free monthly course was given by Professor Daniel C. Eaton, on Hybrids and hybridism.

June 1.—Mr. William E. Hidden described the minerals of special interest at the New Orleans exhibition..

BOSTON SOCIETY OF NATURAL HISTORY, May 20.—Mr. George H. Barton described the ancient land-system of the Hawaiians; Dr. C. S. Minot discussed the causes limiting the duration of organic life.

AMERICAN PHILOSOPHICAL SOCIETY, Feb. 20, 1885.—Mr. Philips exhibited and gave an account of a "writing box" presented in 1785.

March 20.—Dr. Brinton read a paper on the Philosophic grammar of American languages as set forth by Humboldt, and also a paper by Dr. H. Rink on Danish explorations in Greenland and their significance; Dr. Greene presented a paper, by Dr. O. C. S. Carter, On the adulteration of oils.

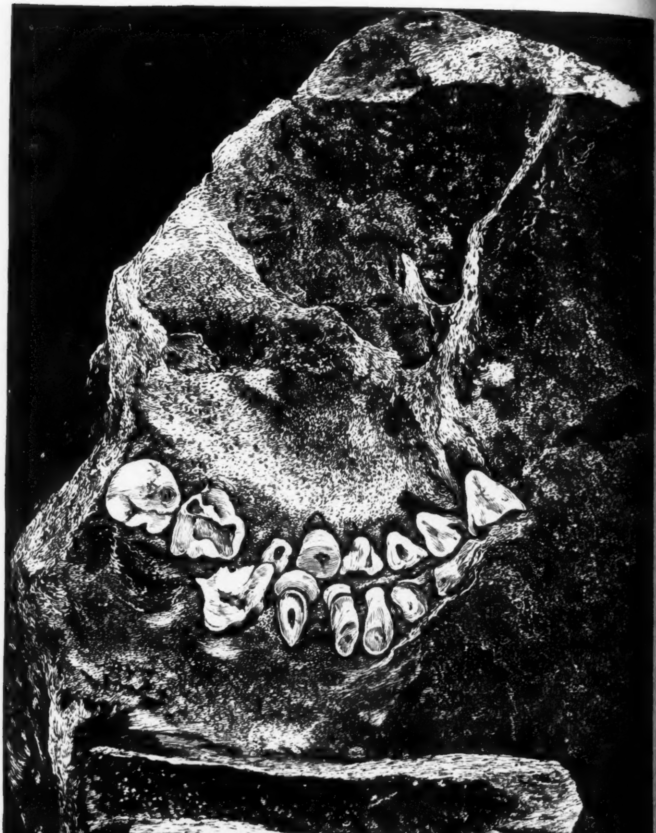
April 21.—Professor Cope presented a communication on Some points in Mexican geology and zoölogy, and also a paper on some new Eocene Vertebrata; Professor F. A. Genth presented a paper on the Vanadites and iodyrites found in Lake valley, Sierra county, Cal.; Mr. W. Taylor presented a paper on the method of making composite photographs on the Galton plan, illustrating his subject with photographs; and Professor Chase sent a proof sheet entitled, "Further experiments in weather forecast, also a paper on the Chase-Maxwell ratio."

May 1.—Dr. H. Allen made a communication on The tarsus of bats.

PLATE XXV.

Fragment of the maxilla of the fossil man of Mexico. From a photograph of the original by Cruces y Ca.

PLATE XXV.



Interior view of palate and both jaws of left side of the fossil man of Mexico.
From a photograph of the original by Cruces y Ca.